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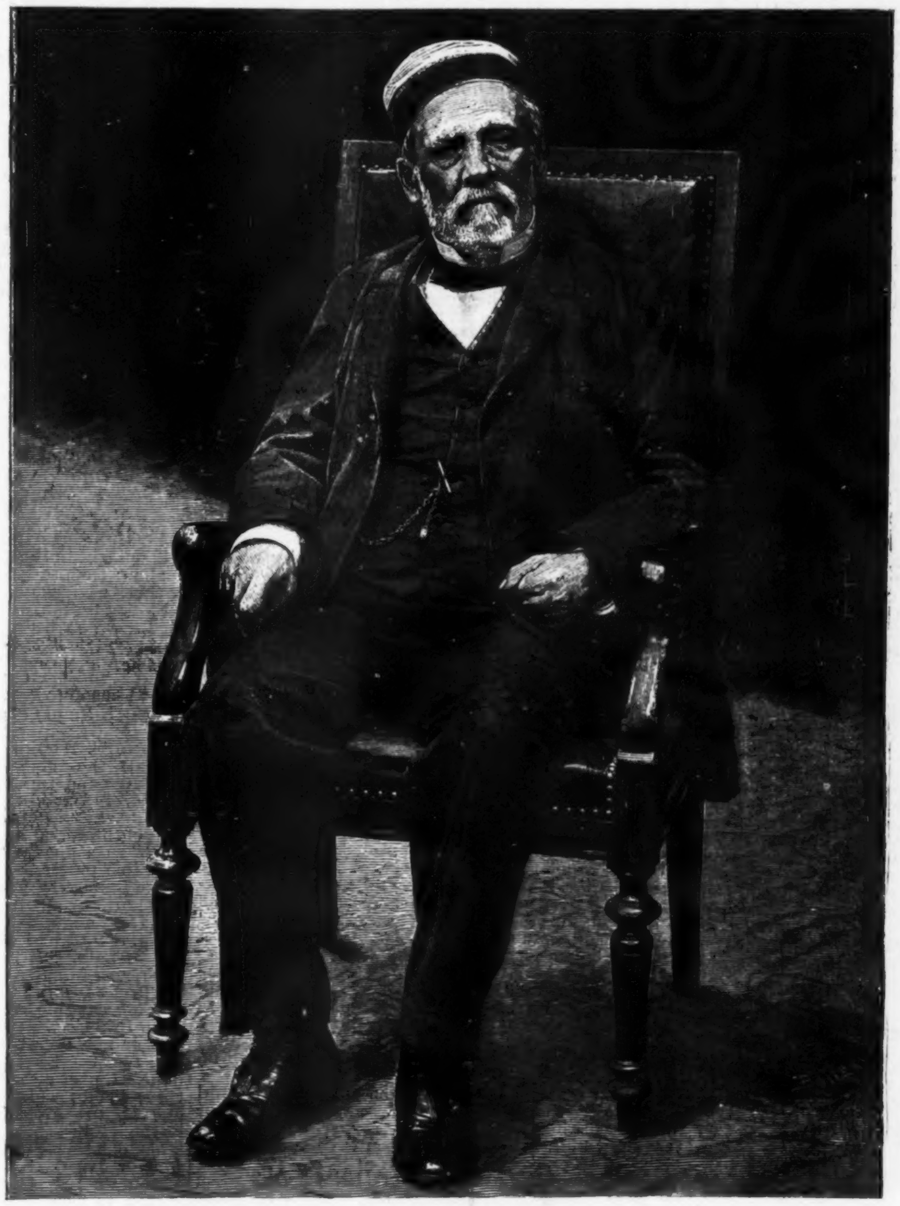
LOUIS PASTEUR.

IN the death of Pasteur there passes away a life that was not merely useful in the ordinary sense, but one that marks a distinct epoch in the progress of human knowledge. He has solved some of the most important problems ever presented to either popular or scientific inquiry, and solved them in a way which opens up a great future to the discoverers who followed him.

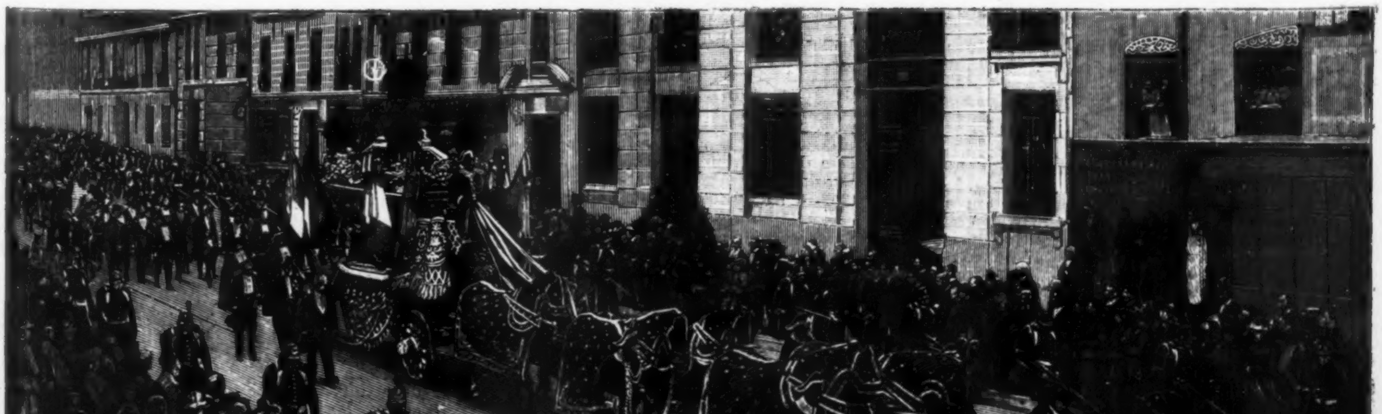
Louis Pasteur, who died on September 28, 1895, was born at Dole, in 1822, and was appointed teacher of chemistry at Besançon, and then at Dijon, and finally was appointed professor of chemistry at Strasbourg, in 1849. In 1857 he conducted the Normal School in Paris, and in 1863 was appointed professor of chemistry at the Sorbonne. He was compelled to resign, on account of ill health, and in 1874 the French government granted him an annual pension of 12,000 francs, which was afterward raised to 20,000 francs. Among his first discoveries was that crystallized organic substances, although having the same chemical properties, have decidedly different physical properties, specially in relation to the refraction of light. He made many valuable discoveries in relation to fermentation, and was able to prove that the process of fermentation, that is, the conversion of sugar into alcohol and carbon dioxide, is due to the vitality of these yeast germs.

Since 1870 Pasteur gave attention to contagious diseases, such as anthrax, chicken cholera, and rabies. His investigations in relation to a plague which broke out among the silk worms in the South of France was of the greatest value. The production of silk in France had almost ceased in 1865 on account of this disease. Pasteur plainly pointed out the cause of the trouble and the means necessary for the alleviation of its effects and ultimate extermination. Another of his discoveries was the treatment of a disease particularly fatal to cattle and sometimes to man, called splenic fever, or wool sorter's disease. The latter plague had been fatal to millions of cattle, but since the adoption of Pasteur's method of inoculation for its prevention, it has now almost disappeared. It was a part of his good fortune that most of his discoveries had such an immediate practical value that his fame was more widely and popularly diffused than has been the case with many scientists whose discoveries, though perhaps equally great, have been in the domain of theory. Although he encountered many obstacles, specially in the early part of his career, the brilliancy of his discoveries gave him at last enduring fame, and he died full of years and honors. We have published a number of papers on Pasteur and his work. See the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 474, 728, 762, 682, 897, 899, 335, 1034.



LOUIS PASTEUR.

The body of Pasteur lay in state in one of the rooms of the Pasteur Institute, which had been converted into a chapelle ardente. The funeral services took place at the Cathedral of Notre Dame, on October 7. At ten o'clock the priest of the parish said prayers over the coffin, which was then covered with a pall and placed on a superb mortuary car drawn by six horses. The Republican Guard headed the procession, and was followed by General Saussier, Military Governor of Paris, and his staff. Then came delegates from societies, municipalities, etc., carrying wreaths. Five floral cars were in the procession, all covered with wreaths. The band of the Republican Guard played a dirge as the procession started for the Cathedral. Directly after the mortuary car was the son of Pasteur, his son-in-law, and his grandson. Then came the President of the Senate and Chamber of Deputies, and various other officials. The procession was about a mile long, and its rear guard was composed of a troop of cavalry. As the mortuary car reached the Cathedral of Notre Dame



THE FUNERAL OF PASTEUR—THE MORTUARY CAR.

the wreaths were placed in the square; the priests of the Cathedral then took charge of the body. At noon M. Faure, President of the French Republic, arrived, and passed under the mourning drapery, which concealed the façade of the church. Among those present were the Grand Duke Constantine, of Russia, Prince Nicholas, of Greece, and many ambassadors. Abbé Marie celebrated the mass, and the choir sang the liturgy during the mass, which lasted one hour and a quarter. The catafalque was erected directly in the center of the square, and a draped rostrum was also built, from which M. Poincare, Minister of Public Instruction, delivered a funeral oration. Archbishop Richard pronounced absolution after the mass. President Faure walked out of the Cathedral between Grand Duke Constantine and Prince Nicholas, and listened to M. Poincare's eulogy of M. Pasteur, in which he reviewed his career and lauded his modesty, valor, and charity. A dense mass of people filled the square. The troops of the army of Paris defiled slowly before the coffin, and the body was then placed in the vault of the Cathedral in the presence of the family. The body will be transferred later to the institute which bears his name. For our illustrations we are indebted to La Science en Famille and Le Monde Illustré.

INOCULATION FOR CHOLERA.

LAST month the medical profession in Bengal assembled to bid god-speed to a savant who is perhaps destined to rank as the Jenner of India. During nearly three years Dr. Haffkine has carried out, at his own cost, one of the most public spirited and arduous tasks which a man of science ever imposed on himself. He determined to bring the results of inoculating for cholera to the test of experiment on a scale, and under verified conditions, which should leave no room for doubt. After performing upward of 40,000 inoculations at cholera centers throughout Northern India, his health gave way from the prolonged strain, and he was unable even to be present at the meeting convened by the Medical Society of Calcutta in his honor. He has now sailed for Europe, broken in health by Assam malaria, but with the happy confidence that he has initiated a work which may prove of incalculable benefit to his fellow men. His mission, said the president of the Calcutta Medical Society, "is as magnificent as it is unique in the history of medicine, and he has carried it out single handed and in the face of difficulties and discouragements which only a man of indomitable purpose could have surmounted."

The farewell address delivered by Surgeon-Lieutenant-Colonel Crombie gives a résumé of the method adopted by Dr. Haffkine and of the exact measure of success attained. Dr. Haffkine's procedure consists of two stages—a preparatory inoculation with a weak virus, which enables the system to receive a second inoculation of a stronger character. The weak virus he developed by passing air and oxygen over a cultivation of the comma bacilli on agar at a high temperature. By this means the bacillus is so modified that when introduced below the skin it causes only a slight local puffiness, followed by a mild constitutional reaction. The modified bacillus thus obtained preserves its gentle character in all subsequent cultivations in agar, and becomes, in fact, a new permanent variety of the comma bacillus. The second inoculation is made with a virus of such strength that it causes death to a guinea pig in eight hours. But when injected into the human subject five days after the preparatory inoculation, it gives rise to only a slight local and constitutional disturbance, thus showing that the body has acquired an immunity against its effects as a consequence of the action of the former milder virus. The symptoms produced by the second virus subside in another five days, "and not till then can it be said that the operation of anti-choleraic inoculation is complete." This point is insisted on both by Dr. Haffkine and by the British medical experts who have watched his proceedings.

The figured statements of results supplied by independent officers in charge of the various hospitals have been subjected to a searching verification. They were impartially collected in the provinces of the Punjab, Oudh, the Northwest, Assam, and the great Lieutenant-Governorship of Bengal, which itself contains one-third of the population of British India. In a total of 42,445 inoculations not a single instance of mishap or injury to health resulted—a marvelous testimony, says the president of the Calcutta Medical Society, "to the persevering care which Dr. Haffkine has taken in the preparation, preservation and exhibition of his vaccine cultivations."

Striking cases are mentioned, such as that at Agra, where cholera entered the house of a head constable and attacked the wife, who had not been inoculated, while the husband, who had been inoculated, passed unscathed. But it is the collated results obtained under independent supervision from large groups of cases which supply the really important evidence. In Calcutta 1,860 inoculations were performed by the health department of the municipality. Cholera occurred in 36 houses in which a certain proportion of their 516 inmates had been inoculated and a certain proportion had not.

Among the uninoculated inhabitants 13·47 per cent. were attacked by cholera, and 11·6 per cent. died. Among the inhabitants partially protected by the first inoculation only 2·2 per cent. were attacked and died. Among those who had undergone the complete second inoculation "there were no cases and no deaths."

We give these figures in their least convincing form. But the president of the Calcutta Medical Society, a perfectly impartial critic, brings out their full significance by deducting the cases which occurred within five days of the first inoculation, that is to say, before even the preparatory injection had time to do its work. Setting aside such instances, he states that there was only one case, of a child, and that this case occurred 459 days after the preparatory inoculation, a period probably sufficient to exhaust its protective force.

The Calcutta municipality were encouraged to carry on the experiment by the results obtained in a localized outbreak of cholera around certain tanks. The outbreak was practically arrested by inoculation. Of the 200 persons living within the infected group of houses, 116 submitted to the operation. Among the remaining 84 not inoculated ten were attacked and seven died. Among the 116 inoculated persons no further cases occurred. Dr. Simpson, health officer for Calcutta, cites several examples of remarkable significance.

Thus in one house four persons out of five were inoculated in May, 1894. During the outbreak of cholera in the following July the disease attacked the only person in this house who had not been inoculated. In another family of seven members, six were inoculated in July, 1894. "In March, 1895, the only one not inoculated was attacked with cholera and died." These statements, it must be remembered, are not the statements of Dr. Haffkine, but of the responsible British authorities, whose duty it was to verify each case.

Evidence has also been obtained from medical officers in charge of gaols in Bengal and of tea plantations in Assam. Even the preparatory inoculation has proved effective in reducing the death rate. "In the Gaya gaol, for instance, the mortality among the not inoculated was twice that among the inoculated." The statistics from the tea plantations deal with small groups of cases, but they furnish individual examples of the protective effects of inoculation. The principal health officer estimates that after even the first inoculation has acted for eight days "the inoculated persons living in the same house in Calcutta are twenty times safer than the uninoculated, should cholera enter the house."

India has suffered many things from the peripatetic philanthropist, and British medical officers in India are apt to watch his proceedings with a critical eye. Even in the case of a bacteriologist of world-wide fame like Dr. Koch, the Indian medical profession found itself compelled to dissent from the hasty methods and conclusions rendered unavoidable by the too brief period allowed for his mission. Professor Haffkine has lived his life before the Indian doctors during nearly three years, and he has completely won their confidence and esteem. The prejudices, apprehensions and not unnatural objections to what seemed a dangerous operation he has calmly and gently overcome. It would be premature to speak with certainty as to the final result of his labors, and all that we can with propriety do in a general article like the present is to state the evidence as verified by independent medical experts. He has performed his self-imposed task, said the chief health officer of the Calcutta municipality, "at a cost out of his private purse of between Rs.30,000 and Rs.40,000. He came to India a healthy man; he leaves it weak and broken down. The work which he accomplished in India stamps him as no ordinary man. His thoughts and labors have been directed to a great end." Controversy may continue with regard to the precise value of inoculation as a prophylactic against cholera. But there can be no controversy as to the disinterestedness of purpose and the nobility of aim with which Dr. Haffkine has labored to protect our soldiers in India and the Indian peoples from that terrible disease.—London Times.

ULCERS OF THE LEG: ALL CAN BE CURED.*

By CARTER S. COLE, M.D.

IT is with no little misgiving that I have selected a topic which to many is threadbare, to more barren, and, possibly, to all a matter of considerable indifference; and I may add that my hesitation has not been lessened by the fact that what I may present does not claim to be startling, unusual, improbable, or sensational; it does not set forth what can be done only by experts, with large experience and unlimited opportunities; it does not attempt to solve conflicting views of pathologists and bacteriologists; it does offer, as the result of a number of years of practical trial in a considerable variety of ulcers, methods which have so far proved themselves uniformly successful. Let me add one fact further, that the systemization and success are largely due to the personal attention to every detail which has been given the subject by Dr. Seneca D. Powell, of the New York Post-graduate Hospital, in whose clinic, for six years, we have no failures to record.

If, then, we may have suggested something helpful on a subject that is not new, but has, in many of our dispensaries in New York City, received scant justice, these few lines will not have been written to no purpose.

Almost the first question the practitioners ask when we have occasion to speak on this subject is, What sort of an ulcer is it? Presuming that this thought has already entered your minds, let us dispose of the matter at once. When constitutional factors exist that favor morbid conditions, or that retard a return to a healthy state, such a diathesis receives its proper treatment, whether or not ulcers exist. If the patient be syphilitic, constitutional treatment directed to the stage and state of his disease is eminently proper; if extreme anemia be present, proper therapeutic measures are wholesome and obligatory; and so if any of a dozen conditions obtain that would retard the process of repair under other circumstances, we would certainly not neglect the same when there was superadded an indurated, foul, long existing ulcer. On the other hand, the cardinal principle of the treatment we shall offer is that the local measures alone can be depended upon, and that these are practically the same whatever be the classification we choose to adopt.

For systematic purposes it may be well to designate ulcers of the leg either according to the appearance (i. e., healthy, irritable, indolent, etc.) or according to the constitutional condition of the patient (i e., eczematous, senile, syphilitic, etc.) For practical purposes we have only to remember that, whatever be the variety, it must be reduced to a simple or healthy ulcer, and kept so until healed. The longer the lesion has obtained, the greater the difficulty in bringing about this condition, and yet it is by no means unusual for us to heal in three weeks an ulcer that has defied treatment for twelve or fifteen years. We have not found a "greased rag" conducive to the healing of any form of ulcer; so far from it, in many of the cases it is the chief cause of failure.

Poultices of charcoal or anything else have to us seemed to do slowly and imperfectly what can be done quickly and efficiently by the method we shall propose. Powders of any sort have, in our experience, seldom done good, and often harm. Ointments, for the ulcer itself, we do not find necessary or helpful; indeed, for the most part, they are positively baneful. As a matter of fact, even where other conditions obtain for which certain ointments are of service, the cure of the ulcer will not be jeopardized by considering that we can do better without any unguent. Lotions, as a whole, we can completely dismiss after the first few dressings, and often even before.

Some are doubtless already reflecting that in discarding ointments, powders, and lotions we have left nothing upon which to stand; indeed, we have been often told that it is simply preposterous to talk about curing an indolent ulcer without such accessories; and yet we are prepared to demonstrate continually that such is the case, and still further to show that the failure for years has often been due to just such measures.

So much, then, in a negative way, toward the treatment of ulcers, and we may be permitted to add that this is quite as important a part of our knowledge as the positive means which we shall now subjoin.

Foremost among the latter, especially in the very intractable cases, we are inclined to place a thorough washing with soap and water, and good scrubbing with a stiff bristle hand brush. If the ulcer is inflamed, irritable, or painful, anesthesia may be required for this and the subsequent steps, and in our experience local anesthetics have not been of much service; indeed, where cocaine or ether locally, or any other anesthetic so employed, is sufficient, the work can be quite as easily done without any.

The next step is a thorough cleaning out of all the soft granulations ("proud flesh"); indeed, we may say of the whole base of the ulcer, by means of a sharp curette. We find the reduced Volkmann spoon (or the original size, if you choose) the most efficient instrument for the purpose. It is not sufficient to skim off the overlying film, though this may become necessary in the further care of the case, but we must scoop out the unhealthy tissue until we come to sound tissue, even though such a procedure carries us to the deep fascia or to the bone itself. A knife will not do the work satisfactorily unless we do a more extensive operation. The edges of the ulcer are then freed from their attachment, especially where they are rounded and bound down, and in many cases we nick the circumference at intervals of about one-quarter of an inch with a sharp, curved bistoury (the edges are already supposed to have been freshened by the sharp curette). If much hemorrhage follows, as is usually the case after such radical measures, a pad of gauze which has been wrung out of a 2 per cent. solution of carbolic acid is placed over the wound, and a firm compression bandage from the toes to the knee applied, the wound having previously been thoroughly cleansed with the carbolic solution. (This same application is sometimes used later for a day or two at a time, when the discharge becomes rapidly offensive, and is irritating the edges of the wound.) This dressing, when used, is allowed to remain usually for twenty-four or forty-eight hours, after which we consider our ulcer to have become a simple one, and amenable to treatment as follows:

No further lotion is used (except as noted above in parenthesis), the wound is wiped off with dry cotton, and over the wound, completely covering it, we place strips of diachylon plaster (the regular surgeon's plaster), not attempting to "strap" the ulcer, but simply to protect it. (We have often used the rubber tissue with good effect, but it does not seem to offer the same protection to the base of the ulcer.) Do not make the mistake of using rubber adhesive plaster next to any open wound, as it almost invariably irritates and seldom heals. Over the surgeon's plaster we put a pad of absorptive gauze—simple sterilized gauze—holding it in place by strips of rubber adhesive plaster, or often simply by the bandage. We then use the firm muslin bandage from the toes to the knee, making equable compression. This, we may add, is done in all cases, whether varicose conditions be present or not, but it is especially necessary in the latter case that the bandaging be carefully and thoroughly done. Sometimes, indeed often, we use two bandages three inches wide and eight yards long. This bandage is not removed unless the discharges come through or the leg becomes painful or the bandage gets loose. This sometimes, in the first few dressings, is as long as four or five days, usually, however, about two days. When we redress, we again use simple dry absorbent cotton to cleanse the wound, and proceed as before. Often after two or three dressings the bandage may remain five to seven days without being disturbed. In some cases a thin "scum" forms on the ulcer, which must be removed by going over the surface lightly with the curette, or, in other cases, by the dry absorbent cotton. Often it simply comes away like the peeling from a peach. It is characteristic, and cannot escape the careful observer, and yet it will frequently, if not removed, prevent a successful result.

In very few cases has skin grafting seemed to offer special advantages, though there is no special objection to its use, if the ulcer be large and in proper condition to utilize the graft. At the third or fourth dressing, the granulations will often get a little exuberant; and at later dressings, even where such is not noticeably the case, after the ulcer has been dried off with the absorbent cotton, lightly brushing over the surface with a solution of nitrate of silver, a drachm to the ounce, will help the process of repair and relieve the itching.

If, when the ulcer is half healed, the granulations are flabby and unhealthy, we simply have to repeat the same steps that we have already indicated. Where an offensive irritating discharge supervenes (as before noted), a carbolic pad for a few days, with or without curetting, will often restore the ulcer to a healthy state. If the discharge be very acid, an alkaline solution, in which to wring out the absorbent pad, may be substituted.

In ordinary cases about three weeks will suffice for an ulcer of even a dozen years' standing; in extraordinary cases as much as six weeks may be necessary. Persistence, patience, perseverance in the methods given, have yet to record an unsuccessful case. The subsequent care of the cases entails, of course, in many cases a support of the circulation, either by a properly adjusted muslin bandage or by a rubber stocking. The rubber bandage has, in our experience, been productive of more harm than good. It is not an easy bandage for the physician to apply, and much less

* Read before the Mississippi Valley Medical Association at Detroit, Mich, September 4, 1895.—From the "American Medico-Surgical Bulletin."

is it apt to be properly put on by the patient. At the first indication that the ulcer is recurring, the adhesive plaster and muslin bandage must again be brought into requisition. Not infrequently a piece of the diachylon plaster, worn for some weeks after a cure has been effected, will be conducive to the permanency of the result and to the comfort of the patient.

I shall not detain you by a record of the many cases in which this method has been demonstrated to be satisfactory and successful, nor need I remind you that several of our most distinguished men have dated their first steps toward success from the cure of some commonplace affection that had for a long time resisted the treatment of older and more experienced men.

I do not believe I am too sanguine in my conviction that "all ulcers can be cured." Whether I may have suggested the lines upon which such a result is possible, time and yourselves are the proper ones to demonstrate. That better and less troublesome means for such a consummation may be forthcoming, we are all, doubtless, justified in hoping and believing; "but such as I have, I give you."

101 West Seventy-fourth Street, New York.

A PARTIAL GLOSSARY OF FODDER TERMS.*

By E. B. HOLLAND.

ACIDS, INORGANIC. — Inorganic acids are combinations of the non-metals (chlorine, phosphorus, etc.) with hydrogen or with hydrogen and oxygen. They possess an extremely sour taste. The most common are hydrochloric (muriatic), phosphoric, sulphuric and nitric acids.

Acids, Organic.—These are chemical combinations of carbon, oxygen and hydrogen, generally possessing a sour taste. United to potash, lime, etc., they form organic salts. Organic acids are found, as a rule, dissolved in the plant juices, and to the largest extent in fruit, silage and green coarse feeds. The most common ones are tartaric, citric, malic, oxalic, acetic and lactic acids. Their exact value as a source of nutrition is unknown.

Organic acids have, as a rule, a favorable effect upon the palatability of a food.

Albuminoids.—Albuminoids are distinct groups of nitrogen containing substances found in all plants and seeds. Their most common forms are seen in the gluten of the grains, albumen (white) of the egg and curd of the milk. They appear in large quantities in seeds and by-products derived from them, such as cotton, linseed, gluten and bean meals. The elementary composition of these bodies is carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus. As a food they serve as the exclusive source of production of flesh, muscle, ligaments, tendons, hide, etc., and of repair of bodily wastes.

Albuminoids are also a source of energy and were formerly considered a source of fat, but this is now doubted.

Alkaloids.—Alkaloids are also nitrogen containing substances, but very different from the albuminoids, occuring in certain distinct plants and possessing poisonous or narcotic properties. They are represented by caffeine, in coffee, and nicotine, in tobacco.

Alkalies.—Alkalies are distinct combinations of oxygen and hydrogen with potassium, sodium, etc. The three common alkalies are potash, soda and ammonia. In common usage, lime, magnesia, etc., are classed as alkalies. They are directly the opposite of acids, and unite with them to form neutral bodies called salts.

Alumina.—Alumina is a metallic substance, rarely present in plants excepting traces in the roots and leaves.

Amides.—Amides are partially formed albuminoids, occurring largely in solution in the juices of immature plants, root crops and silage. In feeding value, however, they are inferior to the albuminoids, but when there is a deficiency in these latter compounds, the amides (especially asparagin, the most common one) seem to act in two directions—as a partial substitute for the albuminoids, and as a body favoring the thorough digestion of the carbohydrates.

Ammonia.—Ammonia is the pungent gas arising from the decay of all nitrogenous substances, such as flesh, horn, horse manure, etc. Traces of ammonia are sometimes present in plants, perhaps due to slight disintegration of the intercellular mass or to incomplete assimilation. It is of no nutritive value, as shown by the direct feeding of ammonia salts.

Ash, crude.—The ash constitutes the inorganic or mineral matter of a plant. It is the portion which remains after burning, the ingredients of which are potash, soda, lime, magnesia, iron, alumina, manganese, sulphuric and phosphoric acids, chlorine, silica, etc. The basic or metallic substances (the first seven named), occur in the plant combined with other inorganic and organic elements.

In nutrition these various constituents serve to build up the bony structure and are to a limited extent a necessary component of the tissues and organs.

Asparagin.—Asparagin is the most important amide present in plants.

Calories.—The calorie is a standard unit of heat. (French). It is the amount required to raise the temperature of one kilogramme (2·2 lbs.) of water through 1·8° Fah., and is equivalent in mechanical energy to 1·53 foot tons. The calorie is used by physiologists to express the comparative amounts of vital energy that the different feeds can produce, when consumed by the animal.

Carbohydrate.—The term carbohydrate is applied inclusively to cellulose and to all such compounds as sugars, starches, gums, etc., usually grouped under the head of "nitrogen free extract." Their component elements are carbon, hydrogen and oxygen, and the digestible portions are considered of equal value and perform the same function in animal nutrition.

Carbon.—Free carbon occurs in the form of diamond, graphite, coal, etc. It is the foundation element of all organic substances, in which it exists in close chemical union with other elements such as oxygen, hydrogen and sometimes nitrogen, phosphorus and sulphur.

Cellulose.—See fiber, crude.

Chlorine.—Chlorine is an inorganic acid forming element, usually present in plants, but only to a limited extent. It is one of the two constituents of common salt.

Chlorophyl.—Chlorophyl is the green pigment which produces the characteristic color of ordinary plants. From a nutritive standpoint it is of no value, being practically indigestible.

Cholesterine.—Cholesterine is a substance somewhat resembling fat of an uncertain nutrient value.

Dextrin.—Dextrin is an intermediate product between starch and sugar.

Digestive co-efficient.—A digestive co-efficient is a figure indicating the percentage of a food ingredient which can be digested and assimilated by an animal—the same having been deduced from actual experiment.

Dry Matter.—Dry matter signifies a material free from water.

Ether Extract.—Ether extract is that portion of the plant soluble in ether. It comprises the group of fatty substances, occurring in the largest amounts in seeds and by products, such a gluten, corn germ, cottonseed, and bean meals.

Among these ether-soluble bodies may be mentioned neutral fats, free fatty acids, vegetable wax, resins, cholesterine, lecithin, and coloring matters such as chlorophyl, etc.

As a nutrient, ether extract produces heat and energy for bodily warmth and force to run the mechanism, serves to prevent undue waste of albuminoids, and when in excess is transformed into animal fat.

Fat, Crude.—Same as ether extract.

Feeding Standards.—Feeding standards are definite combinations of the several groups of nutrients (protein, fat, and carbohydrates) to be fed daily to farm animals in order to attain specific ends. These standards are deduced from the results of a large number of carefully conducted feeding experiments.

Fiber, Crude.—By crude fiber or crude cellulose is meant the woody structure of framework of plants. As a nutrient it produces heat and energy, acts as an economizer of protein, and when in excess of bodily needs is transformed into fatty tissue.

Fodder Ration.—A fodder ration is a distinct amount by weight of coarse fodders and concentrated feeds, so proportioned as to secure a definite feeding standard.

Glyceride.—Glyceride is but another term for ordinary fats. Chemically speaking, a fat is a combination of fatty acids with glycerine.

Gums.—Gums are classified with the carbohydrates, and so far as digestible have an equal food value.

Hydrocarbons.—Hydrocarbons are bodies composed of carbon and hydrogen, but rarely present to any extent in ordinary feed stuffs.

Hydrogen.—Hydrogen in its natural state is the lightest of all gases; when combined with carbon, oxygen and sometimes with nitrogen, sulphur and phosphorus, it forms all kinds of organic substances.

Iron.—Iron is a metallic element, always present in plants, and entering into the composition of blood corpuscles, etc.

Lecithin.—Lecithin is a body somewhat resembling fat, though it contains both nitrogen and phosphorus.

Lignin.—Lignin is a substance probably of an acid character which united with cellulose forms the hard woody part of the plant. In itself it is of little or no nutrient value, being almost wholly indigestible, and furthermore, it prevents to a considerable degree the digestion of other constituents, especially cellulose.

Lime.—Lime is a valuable component of plant ashes, being always present. It is one of the chief constituents of bone.

Magnesia.—Magnesia is an inorganic substance, somewhat resembling lime, always present in plants.

Manganese.—Manganese is a comparatively rare inorganic element, of which traces are occasionally found in plants.

Nitrates.—By nitrate is meant a combination of nitric acid with a so-called base such as soda or potash. Thus nitrate of soda or nitrate of potash are spoken of as nitrates.

Nitric Acid.—This is one of the most important of the inorganic or mineral acids and is a combination of hydrogen, oxygen and nitrogen. It is present in all field and garden crops, being especially noticeable in beets, turnips and the like. Nitrogen enters the plant through the roots chiefly in this form.

Nitrogen.—Nitrogen in its natural state is an inert gas. It exists however combined with a variety of other elements. It is the characteristic element of the albuminoids as well as of nitric acid and ammonia.

Nitrogen-free Extract.—Nitrogen-free extract includes all the organic nitrogen-free compounds of feed stuffs—except crude fiber and the ether extract group—such as cane and grape sugars, starch, dextrin, gum, lignin, coloring matter, organic acids, etc.

Of these various substances, the sugar, dextrin, starch, gums, have the same nutritive effect, so far as digestible, the others being of an inferior value.

As a nutrient, nitrogen-free extract produces heat and energy, serves as an albuminoid economizer, and an excess is transformed into fatty tissues.

Nutrients.—A nutrient is any digestible food constituent which builds up the body or repairs its wastes, produces heat for bodily warmth or energy for carrying on its processes.

The four great groups of nutrients are ash, protein, fat, and carbohydrates

Nutritive Ratio.—By nutritive ratio is meant simply the proportion by weight of the digestible carbohydrates and fat, to the protein, the latter being taken as unity. It has been demonstrated by experiment that, other things being equal, the best returns can be secured in case of milch cows for example if the various feeds are so combined as to produce a ration containing 4·5 to 5·5 as much carbohydrates and fat, as protein, or in other words rations have a nutritive ratio of 1 protein to 4·5 to 5·5 carbohydrates and fat (1 : 4·5 or 1 : 5·5).

CALCULATING A NUTRITIVE RATIO.

In calculating a nutritive ratio, it is necessary to multiply the amount of fat by $2\frac{1}{4}$ to give it a value corresponding to carbohydrates, because the fat furnishes $2\frac{1}{4}$ times as much energy as do hydrocarbates. Suppose a fodder ration to contain the following amounts of digestible nutriments:

	Lb.
Digestible protein	2·70
Digestible fat	0·73
Digestible carbohydrates	12·60
Total digestible	16·03

According to our definition the nutritive ratio would be found as follows:

	Lb.
Carbohydrates	12·60
Fat 0·73 lb. × $2\frac{1}{4}$ =	1·82
Total for fat and carbohydrates	14·42

14·42 lb. carbohydrates ÷ by 2·7 lb. protein = 5·34 or as 1 part of protein is to 5·34 parts of carbohydrates (1 : 5·34).

Organic Matter.—The organic matter of a plant or feed, as the term is used, signifies that portion which can be burned, the elementary composition of which is carbon, hydrogen, oxygen, and nitrogen, which in the plant are more or less intimately associated with inorganic elements.

Oxygen.—Oxygen in its natural state is a gas. When united with other elements it forms many of the most important organic and inorganic substances.

Pectin.—Pectin is the jelly-forming compound of many fruits.

Pentosans.—Pentosans are substances found in the woody portions of plants, closely identified with the cellulose.

Phosphoric Acid.—Phosphoric acid is a combination of oxygen, hydrogen and phosphorus. It is usually found in plants, combined with lime and magnesia, and is usually stored up in the largest quantity in the seed. Phosphate of lime forms the principal mineral part of bone.

Phosphorus is an inorganic element, being the characteristic ingredient of phosphoric acid.

Potash.—Potash is one of the inorganic bases or substances found in all plants, usually in combination with phosphoric or one of the organic acids

Potential Energy.—The potential energy of a fodder or ration is the sum of the heat producing power of its digestible constituents, expressed in terms of the calorie (or foot tons).

Protein, Crude.—By the term protein is meant practically all the nitrogen-containing substance present in ordinary agricultural plants, chief of which, in point of prominence and nutritive value, are the albuminoids, with amides, forming the secondary compounds. (See also albuminoids.)

Ration.—A ration is a food mixture. (See Fodder Rations.)

Resins.—Resins are organic bodies especially rich in carbon and hydrogen, but poor in oxygen. They occur but very little in agricultural plants.

Salt.—Salt is a combination of sodium and chlorine. As an adjunct to a ration, it assists digestion by increasing the secretion of gastric juice and by hastening the diffusion of liquids.

Silica.—Silica is an inorganic substance deposited in the stem, leaves, and outer bark of many plants. It has no direct nutritive value.

Sand.—Sand is fragments of crystals of silica.

Soda.—Soda is one of the alkalies, usually present in plants; and is also a constituent of common salt.

Starch.—Starch is a combination of carbon, hydrogen, and oxygen, and is an important carbohydrate. It is changed to sugar during the process of digestion.

Sugars.—In chemical composition sugars very closely resemble starch. They are soluble in water and entirely digested.

Sulphuric Acid.—Sulphuric acid is a combination of sulphur, oxygen, and hydrogen. United to lime, potash, etc., it forms sulphates.

Water.—Water is a constituent of all feeds. Chemically it is a combination of hydrogen and oxygen. On its presence, to a considerable degree, depend the succulency and palatability of a feed. It is of the first importance in promoting the solution, digestion, and assimilation of the nutrients, and the excretion of waste products.

Wax.—Wax is of limited occurrence in ordinary fodder plants, and is of little or no nutritive value.

* From Bulletin No. 38 of the Hatch Experiment Station, Massachusetts Agricultural College.

LIQUID AIR, A COMMERCIAL COMMODITY.

TIME was when many of our present articles of commerce and trade were mere scientific curiosities, such as only the research chemist was privileged to see, and even then under some difficulty. The tendency of the present age, however, is to turn every new scientific discovery to practical utility. Few could have anticipated the manufacture on a large scale of the complex organic compound benzoyl-sulphonic-imide, which is obtained after a long series of operations which at first were only of interest from a theoretical point of view; but yet saccharin, as it is better known, is now an important article of commerce, familiar to everybody as possessing many hundred times the sweetening power of cane sugar. Solid carbonic acid or carbonic acid snow, to give another example, was not long back viewed in comparatively small quantities with a feeling of awe and wonderment as an interesting specimen of the control which the chemist possessed over some of nature's forces. Now immense quantities of it are made chiefly for aerating beverages, and there are few of us who are not acquainted with the "steel tubes" which contain hundreds of gal-

ions of the "liquid gas," which, by the cold produced by its own evaporation, condenses to a beautiful white solid.

Practically in the same way it is announced that liquid air is now being obtained in commercial quantities. It was only a few years ago that Prof. Dewar produced liquid air in any substantial quantity by his ingenious device of a vacuum jacketed vessel. The intense cold was effected by a series of operations in which liquids of increasingly lower freezing points were successively employed. For the manufacture of liquid air on the large scale which has recently commenced in Germany the employment of intermediate cooling agents has been dispensed with, the cooling effect being obtained by the rapid evaporation of the product itself. Apart from the production of a powerful refrigerating appliance, the process promises to become one of commercial importance, since as the stages in the liquefaction of the air advance it becomes richer in oxygen, until a gas is obtained containing 70 per cent. The oxygen may be further purified, if required, from the nitrogen, of which the gaseous balance, it is said, chiefly consists. As it is, however, the gas may be used in many commercial operations.

We should very much like to know what becomes of the argon in this process. Perhaps at no very distant date we may come to speak of this newly discovered atmospheric constituent as an important by-product, for, in dealing with the enormous volumes of air, as must be the case in the process just described, argon must be encountered in very considerable quantity, and we should not wonder if this newly known constituent of the atmosphere is eventually supplied to research students for simply the asking. As considerable obscurity still surrounds the nature of argon, it is to be hoped that this new departure in manufacture may afford very distinct aid in clearing up these mysteries by placing at the disposal of investigators an unstinted supply of material. Then it would be a happy instance of science helping commerce and commerce in turn helping science.—The Lancet, London.

H. M. S. MAJESTIC.

WE give below a drawing of the first class battle ship Majestic, which has just completed the last of her trials, that of thirty hours under continuous steam at sea.

The Majestic and Magnificent are the forerunners of nine of the same class, are sheathed with 9 in. Harveyed steel plates for a depth of 16 ft. along the sides, the armor extending from apex to apex of a pointed citadel, the length from end to end being about 300 ft. Where the armor passes around the two apices it is reinforced to 14 in., this being also the thickness of the plating on the rest of the barbettes which arise from each end of the citadel, being founded immediately upon the armored deck. This last feature is of true turtle-back character, descending from the center line to the whole depth of a "between decks"—about 8 ft.—at the edges, thus reinforcing a streak of the ship's side to the extent of some 6 in. of Harveyed steel in thickness, over the whole of this depth. For it must be recollected that, though the deck is only 4 in. thick upon the slopes, its potential value for defense is measured by a line passing diagonally through it in its sloping position.

The length of the Majestic between perpendiculars is only 390 ft., but, including the massive ram bow, which projects to a distance of 15 ft., and the hang over of the stern and gallery, the total length over all is about 430 ft. The beam is similar to that of the Royal Sovereign class—75 ft. Hence the increased length has improved the speed of the new vessels, 17·8 knots per hour having been obtained with the Majestic, although the indicated horse power is actually 1,000 less than in the battle ships of the 1889 programme. The displacement is 14,900 tons, exceeding that of any battle ship afloat, in our own or other navies. The performances of the Majestic during her thirty hours' continuous trial were most satisfactory. Steaming gently, without any break, at an average rate of horse power of 6,075, she covered 440 knots in thirty hours; while for every indicated unit of horse power she consumed only 1·84 lb. of coal per hour.

The Majestic has a very imposing appearance afloat. The solidity of the upper battery, and the great height of the breastworks of the superstructure forward and aft, give the idea of a good deal of top hamper. As a matter of fact however, the top hamper is quite as great in the Royal Sovereign, while the upper deck 6 in. quick firers of the latter are only protected by ordinary shields. In the new ships there are closed-in casemates at each corner of the battery, and even double plating above. The rise of the forecastle, which gives an extreme freeboard forward of about 23 ft., also adds to the sea-going appearance of the craft; and, during the thirty hours' run with the Majestic, the value of this feature was most apparent, as, though she plowed up tons of water at the bows, the surf did not come within yards of her deck. The setting back of the bridges and chart houses, away from the influence of the "blast" of the great guns is a most important change. It will be seen in the engraving that the conning tower, especially forward, stands clear of the bridge, so as to give an uninterrupted view all round. The position of the bridges of many of our earlier war vessels, which carry a heavy main armament, would render them most unsafe for those standing upon them when the heavy guns are fired on the beam.

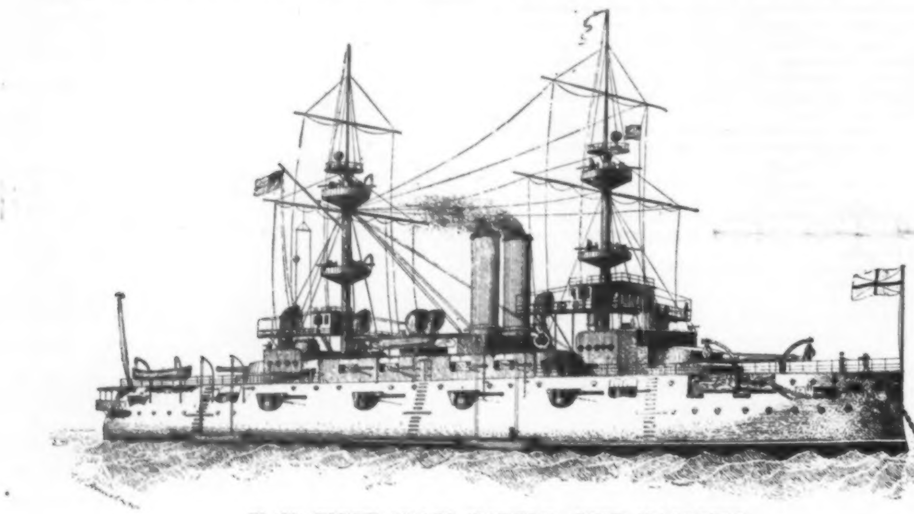
The main armament of the Majestic consists of four 12 in. wire guns of 46 tons, two in each barbette, the breech and body of the gun being protected with a steel hood, having an extreme thickness of 10 in. in front. The method of securing the guns to their cradles is quite novel. Instead of broad bands passing over and strapping the guns on their cradles, as in the arrangement heretofore practiced, "thrust rings" are provided to the 12 in. guns, which fit into corresponding grooves in the cradles, and thus transmit the longitudinal thrust of recoil. Slots in the rings and keys keep the guns down in their places. The "thrust rings" go right round the guns, so that the guns are reversible for convenience. Another deviation from previous customs is the place for loading the guns when "run out," which affords much more room for loading operations in rear of the gun. The system of loading from fixed positions is still adhered to; but it is supplemented in the Majestic by an all round position, which can be adopted at pleasure, and the projectiles for which are kept ready in a revolving chamber beneath the guns, the cartridges being brought up through a central ammunition hoist. The same unfortunate feature, in regard to the mountings for the 12 in. heavy guns, is observable as in our earlier battle ships—the closeness of the deck to the muzzle of the gun when firing axially direct ahead or direct astern. As a matter of fact, during the gun trials of our modern battle ships the axial position is never permitted for the main armament. This is an obvious precaution. We cannot, however, but regret that such a precaution should be necessary. In action it is clear that axial firing would be the rule.

The mountings for the 6 in. quick-fire guns are of a modified pattern, and a decided improvement upon the design of those for vessels of the Royal Sovereign class. They are as usual in cradles, but the trunnions fit into a forging, the pivot of which passes down into a forged steel pedestal fixed to the deck. There are twelve of these guns, eight between decks in casemates and four in the upper deck battery before alluded to, also casemated.

The 12-pounders, sixteen in number, are only protected by a very small shield, which passes round the body of the gun, and does not afford the slightest protection to the crew working the weapon. Shelter for everything has been contrived, except that necessary for the men. Elaborate armored trunks for the ammunition, as it passes up to the level of the deck, have been thought of, but the men are only covered by the slight steel sheets of the battery walls. This we cannot but think is a great blot in the design of the ship. Better to have had fewer guns, if only the upper deck battery could have had walls sufficiently thick to keep out the projectiles of small quick-firers. As matters are at present, it would be swept from end to end, only the corner casemates might prevent a raking fire. The balance of these quick-firing 12-pounders is something most remarkable. In whatever position of training or elevation the gun is placed it remains stationary. Nothing can exceed the beauty of the working of the whole of their mountings.

The accommodation upon the Majestic is not, we think, equal, on the whole, to that of the Royal Sovereign class, though certain features have been most elaborately carried out. The space upon the main deck forward is very fine, as the upper or forecastle deck rises, and gives a great deal of head room. The sick bays are beautifully planned, and the comfort of patients has been well considered. But the cabin accommodation is rather cramped, as was a necessary consequence of having eight between-deck casemates instead of four. This is, however, unavoidable.

The masting of the Majestic is superb, but we should have preferred two fighting tops protected with stout steel plating to the existing four, which would afford absolutely no shelter to the crews occupying them. But the twelve 3-pounders contained in those tops would make an awful sweep of the upper decks of an enemy, so long as the gunners were able to hold out alive.—The Engineer, London.



H. M. FIRST CLASS BATTLE SHIP MAJESTIC.

THE MINING SCHOOLS OF GERMANY.

AMONG the many mining schools of Europe, few, if any, are superior to those of Clausthal, in the Hartz Mountains, and Freiberg, in the mineral mountains of Saxony. Throughout Germany the question of education, especially practical, technical and industrial education, takes precedence of all others. In a recent report on the technical and trade schools of Germany the United States consul at Chemnitz selects the Clausthal establishment as an illustration of what is best in the mining schools of that country. It is surrounded by mineral mountains, into which shafts have been sunk, and at whose bases are situated, in active operation, a great many smelting furnaces, machine shops, and factories. The value of these to the student is incalculable, and much of the success of the school is undoubtedly due to its favorable situation. Its origin, which dates back to the end of the sixteenth century, was due to a desire to furnish regular and exact instruction in the mathematics and mechanics necessary to the successful mining of the many metals and minerals known to be in the surrounding hills. Besides its service to the state on whose soil it is situated, it has received from and sent back to every state in the empire, and almost every foreign country, trained students of almost every trade or profession calling for skill in chemistry, mineralogy, mechanics, mathematics, etc. For four centuries the Hartz Mountains have been worked, and at the present day, in spite of tremendous difficulties, by means of scientific methods these mines are made profitable.

The state works the mines and supports the school. Within a circle of three miles are the most important lead, silver, and copper mines, and the smelting works of the Upper Hartz. Some of the mines are worked to a depth of 3,000 ft., with veins 150 ft. wide. One great advantage the students have is in seeing all kinds of ores smelted. Ores from all countries come from Clausthal to enter the crucibles and come out refined. The school aims at giving such a scientific technical training as will fit the students to take charge of mines and smelting works of all kinds and sizes. There are practically two courses—preparatory and advanced. The preparatory course is to give those who wish to take the advanced or lecture course such a training as will enable them to get all the good out of the advanced course when they arrive at it. To this end the preparatory course carries them through the various works, plants and machinery, until the student is familiar with technical terms, the modus operandi, etc. The course begins each year in the week following Easter Sunday, and continues twenty-four weeks. Eight weeks are devoted to mining, eight to the concentration of ores, and eight to smelting. In the advanced course, the lectures begin in October and close in July. There are very valuable geological collections connected with the school, and for the use of the students. The library has a collection of 14,500 volumes, covering almost every scientific subject, but more especially mines and metals. Besides this the library of the Royal Mining Department (13,500 volumes) is at the disposal of the students; also a collection of over 500 models showing descriptions and structure of veins, rocks, etc.; appliances of various kinds, ancient and improved, for mines and metallurgical operations; machinery for dressing ores; for showing construction of supports, buildings, etc., supplemented by numerous charts and drawings used in illustrating lectures. There is a chemical library, with working room for fifty students at a time, with all the utensils, etc., necessary for practical work, such as preparations and apparatus to illustrate lectures on chemistry, and preparations for chemical technology; an assay laboratory, with everything needed for wet or dry assays; 500 excellent cabinet specimens to illustrate geologic conditions; a general collection of useful minerals, consisting of small specimens from all countries and classified, a collection of metallurgical products, ores, furnaces, fuels, etc.; a collection of instruments such as are used in surveying mines, and many other useful aids to a thorough knowledge of all appertaining to mining and metallurgy.

To be admitted to this school, students must be at least seventeen years old, and must give proofs of a sufficient preliminary education and good moral conduct. Germans must show a certificate that they have gone through a German school of nine classes; foreigners must submit proof of equal qualification. There are special students, who are allowed to enter if it is considered that they have had an education sufficient to enable them to understand the lectures. Special students, after one year's faithful work, are granted the privilege of becoming regular students, by passing a good examination in elementary mathematics. For one hour a week, instruction in assaying, blowpipe, and volumetric analysis, a fee is charged of 4·50 marks (mark=one shilling); one hour in any other branch, 3 marks; daily work in assaying, or in quantitative and qualitative analysis, 60 marks for the winter term, and 45 marks for the summer term, and for one month, 18 marks; for assaying one day per week, 24 marks for the winter term and 18 marks for the summer term. These very moderate fees will show how easy it is for the Germans to get a good technical education. Students may be examined in any subject taught in the school, and in everything in mining and metallurgy. If successful, they get diplomas and certificates of fitness, signed by the proper authorities. There are examination fees of 30 marks, when three students come up at once, and 6 marks for each additional student. For the degrees of mining and metallurgical engineer 75 marks are charged, and 60 marks if for one of these alone, i. e., mining engineer or metallurgical engineer. The studies themselves comprise—(1) trigonometry, algebra and geometry; (2) physics, practical physics, electricity, and mechanical theory of heat; (3) chemistry, theoretical chemistry, practical work in the chemical laboratory, chemical technology; (4) mineralogy, practical mineralogy, general geology, special and practical geology, and ore deposits: (5) elementary mechanics, higher mechanics, instruction in the construction of machines; (6) concentration of ores and mining; (7) surveying; (8) metallurgy and fuels—general metallurgy, special metallurgy, lectures on fuels and metallurgy of iron; (9) blowpipe analysis and assaying; (10) general jurisprudence—historical, Roman, church, German and Prussian laws, private rights, state laws, German mining laws, general doctrines,

ownership of mines, mining companies, miners' customs; (11) political economy—trade statistics and administration; (12) emergency lectures—physiology and anatomy of the human body and how to aid the injured (means, natural and artificial, general aid, aid in special cases, and transportation of the wounded). During the latest year for which returns are available it appears that of the total number of persons attending the Clausthal School, 110 were Germans, 18 English, 1 Dutch, 13 Americans, and 11 students whose nationality was not distinguished.

CHRONOGRAPH FOR STREET RAILWAYS.

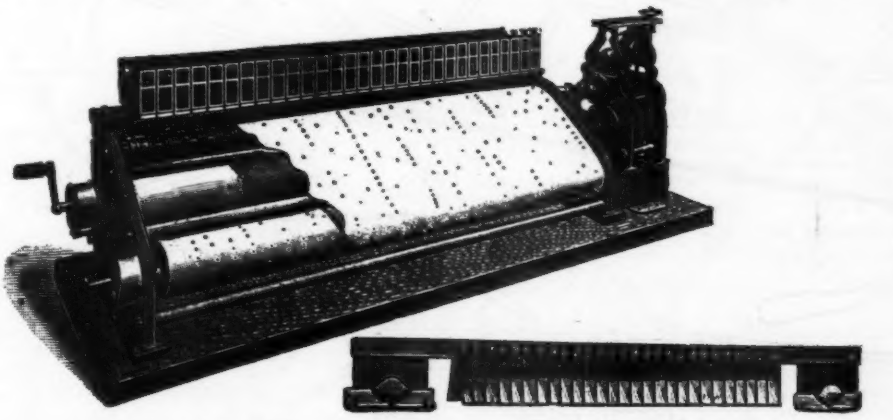
THE apparatus illustrated in the accompanying engravings was designed in response to the need which was felt for knowing how the cars of a system were running, by merely looking at a chart in the central office of the railway. It was thought if such an apparatus could be designed to work successfully it would greatly facilitate the operation of the road, and the experience of nearly two years has proved this to be an established fact.

The chronograph was designed and manufactured by the Emerson Electric Manufacturing Company, of St. Louis, Mo., on the suggestion of Mr. Geo. Baumhoff, superintendent of the Lindell Railway Company of that city, and its operation has proved of the greatest value in giving exact and definite information as to the operation of the road and running time of the cars.

Among a few of the points it shows are the following: 1. Whether the cars are running regularly or irregularly. 2. Whether there is a stoppage at any point. 3. How long the stoppage lasts. 4. How many cars were blocked. 5. When the trouble is removed and the road begins operation again.

These are things every superintendent would like to know while sitting in his office, and he is thus enabled to take a bird's eye view of the operation of the road, with an exact record before him for the preceding two hours of how the cars have been running at each point. If there is a bad break, he can send instruction to fill in with extra cars. If there is irregularity in the running time without good cause, he can check it, and if necessary trace the exact car which is responsible for being off schedule time.

The manner of obtaining all this information is extremely simple, and in fact the success of its operation probably depends upon this simplicity.



THE EMERSON CHRONOGRAPH FOR ELECTRIC ROADS.

The chronograph which is illustrated in the accompanying engraving, Fig. 1, consists primarily of a sheet of paper moving at a uniform rate under a series of pens or points, operated by magnets. Each magnet point represents a point on the road, and each time a car passes this point on the road it makes contact, and the magnet point on the chronograph makes a prick mark on the paper. The illustration shows a thirty point chronograph. That is, it will give a record of how the cars are running at thirty different points on the system, and by selecting these judiciously this will be practically a complete record even on a large system having many branches.

The arrangement of parts as shown is as follows: On the frame is mounted the back roller to hold a supply of paper, the front roller on which to roll up the record, the top plate holding the magnet points, and the top roller which gives the time movement to the sheet. This top roller is a series of grooved wheels one for each magnet point. This is one of the most important parts of the device, as the movement of the sheet must be absolute and exact or the time record will be inaccurate. This roller is operated by a high class and powerful clock movement shown at the right hand side, which moves this time roller one revolution per hour. This is proportioned to give the paper exactly four inches of movement per hour, or one inch for every fifteen minutes, and a line running on a one minute schedule will therefore show fifteen cars or prick marks to the inch, a five minute schedule three to the inch, and so on. A break of two inches would show a stoppage of thirty minutes at that point, and a record showing even, regular points indicates that cars are running all right at that point of the road.

These sheets are dated and filed for reference, and thus a record of the operation of the road is kept, and improvement in service is bound to result from the information thus obtained.

It gives a record of time it took to repair certain damage, and of the exact time at which anything which intefered with the operation occurred. In fact it is a living map of the road, and brings the entire system under the eye of one man at headquarters, at the same time making a permanent record of its operation. It is a report right up to the minute, just when it is needed, and when minutes mean money, and not at the end of the trip or day, when it is too late to provide for trouble which may have occurred.

The engraving, Fig. 2, shows an improved type of trolley contact used in connection with this and other signaling apparatus.—The Electrical Engineer.

CAR FERRIES.

To the student of railroads few things are more interesting than the way in which methods have developed from physical and social conditions; and the physical and social conditions being so different in different countries, results are seldom very closely comparable. Railroad practice in the United States has been immensely modified by the existence of great watercourses to be crossed or paralleled or utilized, and it was the abundance of formidable rivers which from the start called for that boldness and originality in bridge work which soon made American bridge engineers the leaders of the world in their specialty.

Another result of the existence of the great rivers and bodies of inland water has been the development of the car ferry, almost unknown in any other country but which here is an important part of the railroad system. In the notes which follow we have undertaken to put together an account of some of the more important car ferries, but we do not suppose that we have included all of the important ones, and indeed there are several which are not mentioned in these notes.

To begin in the waters surrounding New York, the New Haven and Hartford has long worked an extensive system of transfer of both freight and passenger cars. The floating equipment of this railroad, working from the Harlem River terminus, consists of two transfer steamers, the Maryland and the Express, both of which we have described in times past. The Maryland has a capacity of 6 long passenger cars or 12 freight cars, and the Express a capacity of 10 passenger or 19 freight cars. Then in addition there are 10 large tugs and 35 floats, the latter having a capacity of from 10 to 17 cars each. The Maryland is used principally for transferring the Boston and Washington passenger trains from the dock on the Harlem River to the Pennsylvania station on the west side of the Hudson River. Two of these trains are transferred each way every day. This vessel is also used for transferring freight cars when not required for passenger service. The Express is used as a relief boat for the Maryland when required and at other times for transferring freight.

The New York, New Haven and Hartford connects for freight business with the Long Island Railroad, 6 miles, the Pennsylvania, the Central Railroad of New Jersey, the Lehigh Valley, the Delaware, Lackawanna and Western and the Erie, an average distance of 12 miles. Furthermore, 20 of the smaller floats in service are used between the Harlem River and the local freight stations of the New York, New Haven and Hartford, piers 45 to 52 in the East River. Here the cars stand on the floats until loaded and unloaded, and therefore the floats make but one or two round trips a day. The other 15 floats, which have a capacity of 16 or 17 cars each, make about four round trips a day between the Harlem River landing and the connecting lines in Jersey City, and, as a rule, two of these floats are towed by one tug.

From Jan. 1 to Sept. 1 of this year—that is, in eight months—these floats transferred to and from the railroad connections mentioned above a total of 238 820 cars, and to and from the company's New York piers 74 442 cars, making a total of 313,262 cars handled in the eight months.

Of course the other railroads terminating on the waters of New York harbor, that is, the Pennsylvania, the Erie, the New York Central, the Central of New Jersey, the Long Island, etc., all operate constantly a large floating equipment, the business of which is transferring freight cars between their own termini and their own or other piers in the harbor. For instance, the floating equipment of the Pennsylvania Railroad Company includes 18 tug boats, 45 barges and 65 car floats. The floating equipment of the New York Central includes 20 propellers and steam tugs, 64 barges and 27 floats. The greater part of this equipment in both cases is employed in the waters of New York harbor. The Long Island Railroad has seven floats, two of 17 cars capacity each, with three tracks. These carry cars to and from the Pennsylvania terminal in Jersey City and to other piers in the harbor.

The capacity and flexibility of this method of handling freight, the cheapness with which it is done, the ease with which cars can be delivered to any point on the water front, the unlimited development of which the system is capable, are all elements which conspire to make any bridge across the North River or any tunnel underneath that river a superfluity, so far as handling freight may go. This is a fact which is well understood by promoters in this country, but which should be carefully borne in mind by foreigners who are asked to invest in such projects; and all rail connection with Manhattan Island must, it appears to us, depend for its revenue almost entirely upon passenger business, and for reasons which we need not go into here, upon a small percentage of that business.

The car ferries working in the waters of New York harbor are, of course, subject to no stress of weather other than fog and running ice in winter, and yet the East River is so crowded with traffic that navigation there is about as close as anywhere on earth.

Quite a different set of conditions is found in the car ferry of the New York, Philadelphia and Norfolk Railroad running between Cape Charles and Norfolk, Va. This service was begun on the completion of the railroad in November, 1884, and has been in successful operation ever since. The distance is 36 miles. Here the floating equipment consists of two steamers which run in connection with the passenger trains, three tugs and four barges. The two passenger steamers do not carry cars. They are stout and seaworthy propellers which carry the train passengers and also carry on deck a good deal of loose freight. When the road was first opened a transfer steamer was put in service with the purpose of transferring through passenger cars between Cape Charles and Norfolk, and this service was successfully carried on for a year or two, transferring passenger coaches and sleeping cars regularly. At that time, however, the company had no through connection south of Norfolk and the service was abandoned and the transfer of passengers has since been made by the propellers which we have mentioned.

The tugs and barges transfer the freight cars across the bay. The largest of these barges is 311 ft. long and 37 ft. beam. It is built of iron, has four tracks and has a capacity of 24 large box cars. The average time made by a tug towing one barge across the bay in good weather is 4½ hours, and towing two barges, which is often done when the weather is favorable, from 5 to 5½ hours. The total number of freight cars transferred in both directions in the year 1894 was 36,772. At the Cape Charles terminus there are two double track transfer bridges transferring the cars between the barges and the railroad track. At Norfolk and Portsmouth are similar bridges which transfer cars from the barges directly to the Atlantic Coast line, Seaboard and Roanoke, and the Norfolk and Southern railroads and other connections.

This route lies right across the mouth of the Chesapeake Bay, exposed to the heavy Atlantic seas, and one would suppose that the business might often be interrupted. In fact, however, there are probably on an average not more than half a dozen days in the year when the barges are unable to cross.

Leaving the Atlantic coast we find on Lake Erie a new car ferry service, which promises to be important. This is the enterprise recently started by the Pittsburg, Shenango and Lake Erie Railroad, although we believe that the transfer line is under the control of a separate company, organized under the name of the United States and Ontario Steam Navigation Company. The purpose of this service is to make a direct car connection between the Pittsburg, Shenango and Lake Erie at Conneaut Harbor, Lake Erie, and the Grand Trunk at Port Dover, Ont., a distance of 65 miles. One vessel has been in service here since about Sept. 1, and at the last information which we received, it was expected that the second one would begin running about Oct. 10. These vessels are calculated to carry 26 30-ton cars or 30 smaller cars each. They are built by the Craig Ship Building Company, of Toledo, O., are about 300 ft. long, 52 ft. wide and 53 ft. deep from the top of the pilot house to the keel. They draw 12 ft. when fully loaded. Each boat has four tracks and the hulls are of white oak, with steel outside of the planking. They have compound engines with a total of 2,000 H. P., have twin screws in the stern and a large club screw at the bow. The vessels are fitted up with electric and search lights, steam capstans and steam steering apparatus. The trips are made in from five and a half to six hours, and it is said that they can be loaded and unloaded at either port in an hour. The builders guarantee a speed of 13 miles an hour in ordinary weather.

The vessels have limited passenger accommodations for regular passengers, but can accommodate on the decks from 1,000 to 1,500 excursionists in pleasant weather. So far no severe weather has been encountered, but it is not believed that there will be any difficulty in making the regular trips through the winter, except, perhaps, when ground ice prevents their getting into the docks.

Going westward we find the important car ferries at Detroit. The principal one is operated by the Michigan Central, although the Grand Trunk and the Canadian Pacific both transfer cars across the Detroit River at this point. The service is severe at times because of heavy running ice and the vessels used are stanch. The last one of which we have any description is the Transfer, of the Michigan Central. This vessel is 280 ft. long; 45 ft. 6 in. breadth of hull; 74 ft. 6 in. across the guards, and 17 ft. 3 in. deep. She is built of steel throughout. With 21 loaded cars she draws 11 ft. forward and 12 ft. aft. Her bow is strongly constructed, because of the ice service, and she has a steel deck and bulkheads. She has a paddle wheel on either side worked by independent engines; also a screw.

At Sarnia and Port Huron, across the St. Clair River, the Grand Trunk has long had a car transfer which is now to a considerable degree replaced by the St. Clair tunnel.

One of the most interesting of the car ferry systems is that of the Grand Rapids and Indiana Railroad, across the Strait of Mackinaw, seven miles. Here during most of the year there are no difficulties in operation, but in winter the ice is heavy; but there the boats are seldom delayed. The two transfer steamers employed here have a single screw at each end and are ordinarily run with both screws working. Their car capacity is 11 freight cars for one and 18 for the other.

An important car ferry service across Lake Michigan was begun nearly three years ago. This is the line run by the Toledo, Ann Arbor, and North Michigan Railway between Frankfort, Mich., and Kewaunee, Wis., a distance of 62 miles. The service was inaugurated in December, 1892, and the only interruption to winter service has come from ground ice in the eastern harbor. No interruption has taken place when 20 ft. of water could be secured in the harbor. Two boats are run, having a capacity of about 40,000 cars a year. They are entirely self-contained, and no floats are used. These vessels are 272 ft. long, 52 ft. beam, have four tracks and can carry 24 box cars. Their average capacity is 10 miles an hour, and the necessary time in port one hour. These vessels also run now to Menominee and Gladstone, 80 and 99 miles respectively.

The most ambitious scheme for the transfer of cars

by water between railroad termini is the new one of the Lake Michigan Car Ferry Transportation Company, which we described Sept 6, page 586. Three companies are concerned in this, the Wisconsin and Michigan Railway Company, which owns a line from Peshtigo, on Green Bay, to Faithorn Junction, on the Minneapolis, St. Paul and Sault Ste. Marie Railroad; the Lake Michigan Car Ferry Transportation Company, and the South Chicago Terminal Company. The Wisconsin and Michigan Railway Company is, we understand, the controlling organization. The distance from South Chicago to Peshtigo Harbor is about 240 miles, and the service here is by specially built vessels carrying the trains of cars on their decks, but with no power for propelling. The only steam power that they have is for working the steam towing apparatus. The vessels are towed by powerful towboats. Each of these vessels can carry 28 freight cars. They are 316 ft. long, 24 ft. wide and draw 7 ft. They have four tracks on the main deck and the freeboard is high enough to protect the cars except in very high seas. One of these vessels was put in service about the end of August. A second one is now in service, and it is the purpose of the company to build a third during the winter. These vessels are towed by a steel hawser wound on a drum on the towed vessel, which drum is geared directly to a small engine, making an elastic connection; the strain of the hawser is always acting directly against the steam. This arrangement is very speedy and convenient for changing the distance between the towing vessel and the vessel towed, and makes the handling of the vessels in port very expeditious; that is, the towed vessel is pulled up to the stern of the propeller and taken right into her dock.

The voyage from port to port is made in from about 28 to 30 hours. The loads so far have been mostly lumber and railroad ties, although it is expected to invade the ore country and bring down ore to South Chicago. At South Chicago the loaded cars are delivered to the Chicago, Rock Island and Pacific, also to the Chicago and Western Indiana Belt Line, which gives direct connection with most of the railroads reaching Chicago. It is the expectation of the operating company that this method of handling freight cars will show such savings in loading and unloading, trimming cargo, maintenance of track and rolling stock, and otherwise, as will lead to a great development of the system. Regarding this we venture no opinion; but at any rate it is a bold experiment and one which goes some way to disprove the assertion of Prof. George Forbes that the Americans are a people without imagination.

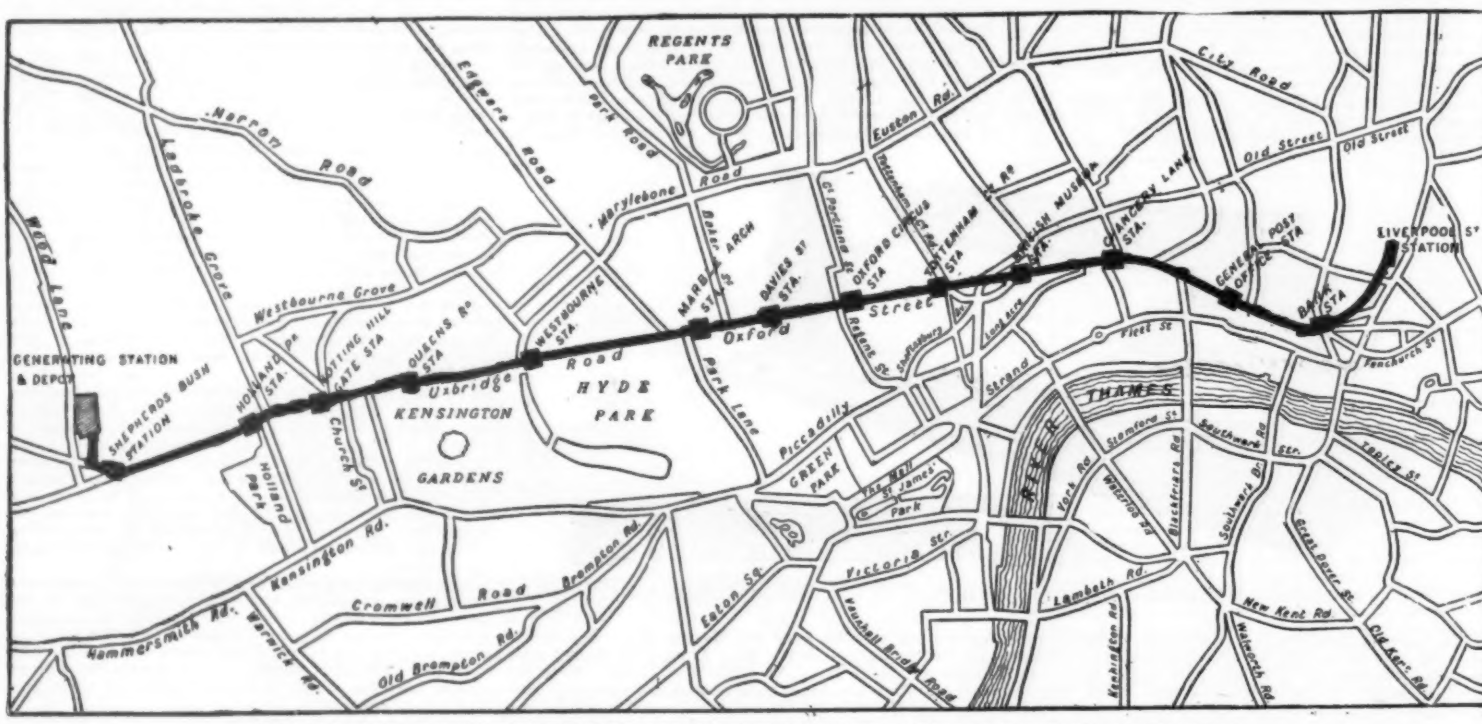
The car ferries of the Southern Pacific system in California are important. As long ago as 1880 the ferryboat Solano was built to work the traffic across the Straits of Carquinez on the route from Sacramento to San Francisco. This vessel is 424 ft. long over all, 116 ft. wide over the guards and has four tracks which are supported by longitudinal, Pratt trusses under the track deck. These tracks will accommodate 24 long passenger cars, or 48 freight cars, with locomotives attached. The vessel is provided with 11 watertight transverse bulkheads. The aprons at Benicia and Port Costa are arranged so that freight and passenger trains can be run aboard without being uncoupled from the locomotives, and each apron has four tracks.

In these notes we have given brief accounts of the longest, the most difficult and the most peculiar of the car ferries of the United States, but do not profess to have mentioned them all.—Railroad Gazette.

THE CENTRAL LONDON RAILWAY.

THE question of how to deal with the enormous traffic of the streets of London is a serious one, and any scheme which will relieve our crowded thoroughfares and supply a speedy means of communication along the great streams of traffic deserves public support apart altogether from financial considerations. To meet the demand for transport omnibuses have taken possession of the main streets in their thousands and have completely spoilt what beauty they may possess as fine thoroughfares. The route of the proposed line is, for instance, crowded from morn till night with omnibuses, and here especially is an opportunity of demonstrating how successfully a rapid electric railway could meet the public requirements. The map given below speaks for itself, and every Londoner will appreciate the advantages of a line commencing at Shepherd's Bush and running under the great east and west highway to the very heart of the City.

Apart from atmospheric difficulties, the enormous value of land in London has effectually settled the possibility of railway extension in the metropolis on the old system, and the public would never allow the streets to be absolutely disfigured by "elevated" lines as established in New York. Fortunately an engineer, Mr. Greathead, hit upon the plan of running two tunnels—one for the "up" and the other for the "down" traffic—by an ingenious system described in our columns on previous occasions, beneath the public thoroughfares, and at such a depth as not to interfere with the vast network of sewers and gaspipes which underlie the City. This system is now quite beyond the experimental stage, its success having been fully demonstrated by the working of the City and South London line, and the extensive construction operations on the City and Waterloo line. There is no question therefore as to the engineering features of the central London scheme, and there is equally little doubt of the enormous advantage of such a line, worked by electricity, and thus securing good ventilation, for the public. The subways for the general public at the Mansion House—the most crowded point of the City—which form part of the scheme, should alone secure it the hearty support of the city authorities. It is understood that all the capital has been underwritten, but the public will be offered a share in the undertaking.—Daily Graphic.



PROPOSED NEW UNDERGROUND RAILWAY FOR CENTRAL LONDON.

STRENGTH OF BRIDGE AND TRESTLE TIMBERS.*

YOUR committee appointed to report on "Strength of bridge and trestle timbers, with special reference to Southern yellow pine, white pine, fir and oak," desires to present herewith, as part of their report, the very valuable data, compiled by the chairman of the committee, relative to tests of the principal American bridge and trestle timbers and the recommendations of the leading authorities on the subject of strength of timber during the last twenty-five years, embodied in the appendix to this report and tabulated for easy reference in the accompanying tables i and ii.

The uncertainty of our knowledge relative to the strength of timber is clearly demonstrated after a perusal of this information and emphasizes, better than long dissertations on the subject, the necessity for more extensive, thorough and reliable series of tests, conducted on a truly scientific basis, approximating as nearly as possible actual conditions encountered in practice.

The wide range of values recommended by the various recognized authorities is to be regretted, especially so when undue influence has been attributed by them in their deductions to isolated tests of small size specimens, not only limited in number, but especially defective in not having noted and recorded properly the exact species of each specimen tested, its origin, condition, quality, degree of seasoning, method of testing, etc.

The fact has been proved beyond dispute that small size specimen tests give much larger average results than full size tests, owing to the greater freedom of small selected test pieces from blemishes and imperfections and their being, as a rule, comparatively drier and better seasoned than full size sticks. The exact increase, as shown by tests and by statements of different authorities, is from 10 to 100 per cent.

Great credit is due to such investigators and experimenters as Professors G. Lanza, J. B. Johnson, H. T. Bovey, C. B. Wing and Messrs. Onward Bates, W. H. Finley, C. B. Talbot and others, for their experimental work and agitation in favor of full size tests. Professors G. Lanza, R. H. Thurston and Wm. H. Burr have contributed valuable treatises on the subject of strength of timber. The extensive series of small and full size United States government tests, conducted in 1880 to 1882 at the Watertown arsenal under Col. T. T. S. Laidley, and more recently the very elaborate and thorough timber tests being conducted by the United States Forestry Division under Dr. B. E. Fernow, chief, and Professor J. B. Johnson, of Washington University, St. Louis, afford us to-day, in connection with the work of the above mentioned experimenters, our most reliable data from a practical standpoint.

The test data at hand and the summary criticisms of leading authorities seem to indicate the general correctness of the following conclusions:

1. Of all structural materials used for bridges and trestles, timber is the most variable as to the properties and strength of different pieces classed as belonging to the same species; hence impossible to establish close and reliable limits of strength for each species.

2. The various names applied to one and the same species in different parts of the country lead to great confusion in classifying or applying results of tests.

3. Variations in strength are generally directly proportional to the density or weight of timber.

4. As a rule, a reduction of moisture is accompanied by an increase in strength; in other words, seasoned lumber is stronger than green lumber.

5. Structures should be, in general, designed for the strength of green or moderately seasoned lumber of average quality and not for a high grade of well seasoned material.

6. Age or use do not destroy the strength of timber, unless decay or season checking takes place.

7. Timber, unlike materials of a more homogeneous nature, as iron and steel, has no well defined limit of elasticity. As a rule, it can be strained very near to the breaking point without serious injury, which accounts for the continuous use of many timber structures with the material strained far beyond the usually accepted safe limits. On the other hand, sudden and frequently inexplicable failures of individual sticks at very low limits are liable to occur.

8. Knots, even when sound and tight, are one of the most objectionable features of timber, both for beams and struts. The full size tests of every experimenter have demonstrated, not only that beams break at knots, but that invariably timber struts will fail at a knot or owing to the proximity of a knot, by reducing the effective area of the stick and causing curly and cross-grained fibers, thus exploding the old practical view that sound and tight knots are not detrimental to timber in compression.

9. Excepting in top logs of a tree or very small and young timber, the heart wood is, as a rule, not as strong as the material farther away from the heart. This becomes more generally apparent in practice, in large sticks with considerable heart wood cut from old trees in which the heart has begun to decay or been wind shaken. Beams cut from such material frequently season check along middle of beam and fail by longitudinal shearing.

10. Top logs are not as strong as butt logs, provided the latter have sound timber.

11. The results of compression tests are more uniform and vary less for one species of timber than any other kind of test; hence, if only one kind of test can be made, it would seem that a compressive test will furnish the most reliable comparative results.

12. Long timber columns generally fail by lateral deflection or "buckling" when the length exceeds the least cross sectional dimension of the stick by 20, in other words, the column is longer than 20 diameters. In practice the unit stress for all columns over 15 diameters should be reduced in accordance with the various rules and formulas established for long columns.

13. Uneven end bearings and eccentric loading of columns produce more serious disturbances than usually assumed.

14. The tests of full size long compound columns,

* Committee's report on "Strength of Bridge and Trestle Timbers," presented at the fifth annual convention of the American International Association of Railway Superintendents of Bridges and Buildings at New Orleans, La., October 15, 1895.

TABLE 1.

—AVERAGE ULTIMATE BREAKING UNIT STRESSES IN POUNDS PER SQUARE INCH.—

—RECOMMENDED BY THE COMMITTEE ON "STRENGTH OF BRIDGE AND TRESTLE TIMBERS."—

AMERICAN ASSOCIATION OF RAILWAY SUPERINTENDENTS BRIDGES AND BUILDINGS.—5th ANNUAL CONVENTION, NEW ORLEANS, OCTOBER 1895.

KIND OF TIMBER.	TENSION.		COMPRESSION.			TRANSVERSE RUPTURE.		SHEARING.	
	With Grain.	Across Grain.	With Grain.		Across Grain.	Extreme Fiber Stress.	Modulus of Elasticity.	With Grain.	Across Grain.
			End Bearing.	Columns under 15 Diams.					
White Oak	10000	2000	7000	4500	2000	6000	1100000	800	4000
White Pine	7000	500	5500	3500	800	4000	1000000	400	2000
Southern, Long-Leaf or Georgia Yellow Pine	12000	600	8000	5000	1400	7000	1700000	600	5000
Douglas, Oregon & Washington Fir or Pine — Yellow Fir	12000	—	8000	6000	1200	6500	1400000	600	—
Douglas, Oregon & Washington Fir or Pine — Red Fir	10000	—	—	—	—	5000	—	—	—
Northern or Short-Leaf Yellow Pine	9000	500	6000	4000	1000	6000	1200000	400	4000
Red Pine	9000	500	6000	4000	800	5000	1200000	—	—
Norway Pine	8000	—	6000	4000	800	4000	1200000	—	—
Canadian (Ottawa) White Pine	10000	—	—	5000	—	—	—	350	—
Canadian (Ontario) Red Pine	10000	—	—	5000	—	5000	1400000	400	—
Spruce and Eastern Fir	8000	500	6000	4000	700	4000	1200000	400	3000
Hemlock	6000	—	—	4000	600	3500	900000	350	2500
Cypress	6000	—	6000	4000	700	5000	900000	—	—
Cedar	8000	—	6000	4000	700	5000	700000	—	1500
Chesnut	9000	—	—	5000	900	5000	1000000	600	1500
California Redwood	7000	—	—	4000	800	4500	700000	400	—
California Spruce	—	—	—	4000	—	5000	1200000	—	—

TABLE 2.

—AVERAGE SAFE ALLOWABLE WORKING UNIT STRESSES IN POUNDS PER SQUARE INCH.—

—RECOMMENDED BY THE COMMITTEE ON "STRENGTH OF BRIDGE AND TRESTLE TIMBERS."—

AMERICAN ASSOCIATION OF RAILWAY SUPERINTENDENTS BRIDGES AND BUILDINGS.—5th ANNUAL CONVENTION, NEW ORLEANS, OCTOBER 1895.

KIND OF TIMBER.	TENSION.		COMPRESSION.			TRANSVERSE RUPTURE.		SHEARING.	
	With Grain.	Across Grain.	With Grain.		Across Grain.	Extreme Fiber Stress.	Modulus of Elasticity.	With Grain.	Across Grain.
			End Bearing.	Columns under 15 Diams.					
Factor of Safety.	Ten.	Ten.	Five.	Five	Four.	Six.	Two	Four.	Four
White Oak	1000	200	1400	900	500	1000	550000	200	1000
White Pine	700	50	1100	700	200	700	500000	100	500
Southern, Long-Leaf or Georgia Yellow Pine	1200	60	1600	1000	350	1200	850000	150	1250
Douglas, Oregon & Washington Fir or Pine — Yellow Fir	1200	—	1600	1200	300	1100	700000	150	—
Douglas, Oregon & Washington Fir or Pine — Red Fir	1000	—	—	—	—	800	—	—	—
Northern or Short-Leaf Yellow Pine	900	50	1200	800	250	1000	600000	100	1000
Red Pine	900	50	1200	800	200	800	600000	—	—
Norway Pine	800	—	1200	800	200	700	600000	—	—
Canadian (Ottawa) White Pine	1000	—	—	1000	—	—	—	100	—
Canadian (Ontario) Red Pine	1000	—	—	1000	—	800	700000	100	—
Spruce and Eastern Fir	800	50	1200	800	200	700	600000	100	750
Hemlock	600	—	—	800	150	600	450000	100	600
Cypress	600	—	1200	800	200	800	450000	—	—
Cedar	800	—	1200	800	200	800	350000	—	400
Chesnut	900	—	—	1000	250	800	500000	150	400
California Redwood	700	—	—	800	200	750	350000	100	—
California Spruce	—	—	—	800	—	800	600000	—	—

composed of several sticks bolted and fastened together at intervals, show essentially the same ultimate unit resistance for the compound column as each component stick would have, if considered as a column by itself.

15. More attention should be given in practice to the proper proportioning of bearing areas, in other words, the compressive bearing resistance of timber with and across grain, especially the latter, owing to the tendency of an excessive crushing stress across grain to indent the timber, thereby destroying the fiber and increasing the liability to speedy decay, especially when exposed to the weather and the continual working produced by moving loads.

The aim of your committee has been to examine the conflicting test data at hand, attributing the proper degree of importance to the various results and recommendations, and then to establish a set of units that can be accepted as fair average values, as far as known to-day, for the ordinary quality of each species of timber and corresponding to the usual conditions and sizes of timbers encountered in practice. The difficulties of executing such a task successfully cannot be overrated, owing to the meagerness and frequently the indefiniteness of the available test data, and especially the great range of physical properties in different sticks of the same general species, not only due to the locality where it is grown, but also to the condition of the timber as regards the percentage of moisture, degree of seasoning, physical characteristics, grain, texture, proportion of hard and soft fibers, presence of knots, etc., all of which affect the question of strength.

Your committee recommends, upon the basis of the test data at hand at the present time, the average units for the ultimate breaking stresses of the principal timbers used in bridge and trestle constructions shown in the accompanying table.

In addition to the units given in the table, attention should be called to the latest formulas for long timber columns, mentioned more particularly in the Appendix to this report, which formulas are based upon the results of the more recent full-size timber column tests and hence should be considered more valuable than the older formulas derived from a limited number of small size tests. These new formulas are Professor Burr's, App. I; Professor Ely's, App. J; Professor Stanwood's, App. K; and A. L. Johnson's, App. V; while C. Shaler Smith's formulas will be better understood after examining the explanatory notes contained in App. L.

Attention should also be called to the necessity of examining the resistance of a beam to longitudinal shearing along the neutral axis, as beams under transverse loading frequently fail by longitudinal shearing in place of transverse rupture.

In addition to the Ultimate Breaking Unit Stress, the designer of a timber structure has to establish the Safe Allowable Unit Stress for the species of timber to be used. This will vary for each particular class of structures and individual conditions. The selection of the proper "Factor of Safety" is largely a question of personal judgment and experience, and offers the best opportunity for the display of analytical and practical ability on the part of the designer. It is difficult to give specific rules. The following are some of the controlling questions to be considered.

The class of structure, whether temporary or permanent, and the nature of the loading, whether dead or live. If live, then whether the application of the load is accompanied by severe dynamic shocks and pounding of the structure. Whether the assumed loading

for calculations is the absolute maximum rarely to be applied in practice or a possibility that may frequently take place. Prolonged heavy steady loading and also alternate tensile and compressive stresses in the same piece will call for lower averages. Information as to whether the assumed breaking stresses are based on full size or small size tests or only on interpolated values, averaged from tests of similar species of timber, is valuable in order to attribute the proper degree of importance to recommended average values. The class of timber to be used and its condition and quality. Finally the particular kind of strain the stick is to be subjected to and its position in the structure with regard to its importance and the possible damage that might be caused by its failure.

In order to present something definite on this subject, your committee presents the accompanying table showing the average safe allowable working unit stresses for the principal bridge and trestle timbers, prepared to meet the average conditions existing in railroad timber structures, the units being based upon the ultimate breaking unit stresses recommended by your committee and the following factors of safety, viz.:

Tension, with and across grain....	10
Compression, with grain	5
Compression, across grain....	4
Transverse rupture, extreme fiber stress....	6
Transverse rupture, modulus of elasticity..	2
Shearing, with and across grain	4

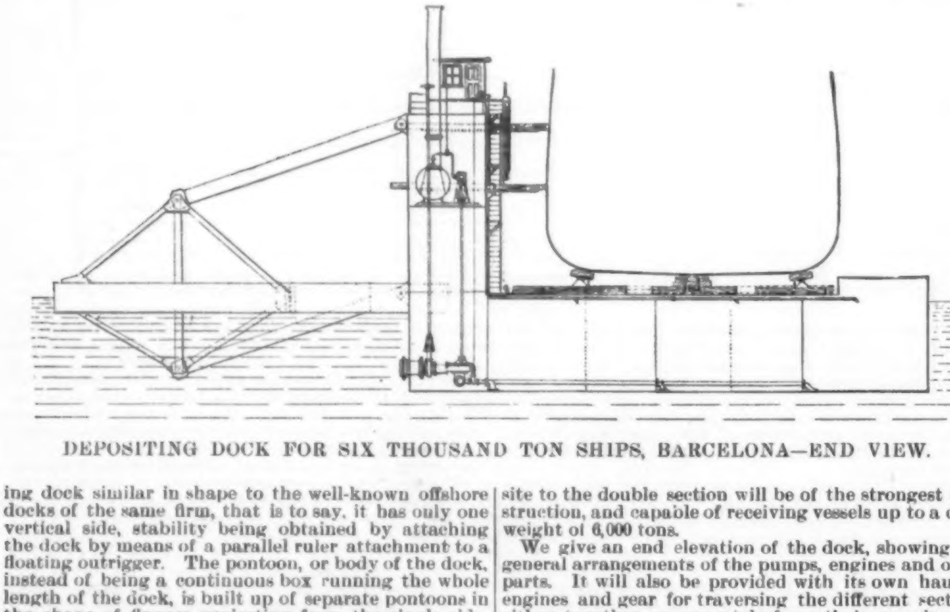
In conclusion your committee desires to emphasize the importance and great value to the railroad companies of the country of the experimental work on the strength of American timbers being conducted by the forestry division of the United States Department of Agriculture and to suggest that the American Association of Railway Superintendents of Bridges and Buildings indorse this view by official action and lend its aid in every way possible to encourage the vigorous continuance of this series of government tests, which bids fair to become the most reliable and useful work on the subject of strength of American timbers ever undertaken. With additional and reliable information on this subject far-reaching economies in the designing of timber structures can be introduced, resulting not only in a great pecuniary saving to the railroad companies, but also offering a partial check to the enormous consumption of timber and the gradual diminution of our structural timber supply.

WALTER G. BERG, Chairman,
J. H. CUMMIN,
JOHN FOREMAN,
H. L. FRY, Committee.

IMPROVED DEPOSITING DOCK.

THE lack of docking accommodation of any sort in the port of Barcelona has given rise to a problem that has occupied the attention of the harbor board of that port for many years past, and the different schemes that have been proposed have been very numerous. A solution was, however, at last arrived at by the decision to install one of Messrs. Clark and Standfield's patent depositing docks, together with two lengths of depositing grid, for the acquisition of which a public competition was opened last year. Three tenders were sent in, but things move slowly in Spain, and it was only during the past summer that the result of the competition was declared, the successful applicants being the firm of Clark and Standfield, Westminster, the original inventors of the system, working in conjunction with the firm of the Maquinista Terrestre et Maritime, of Barcelona, it being one of the conditions of the competition that the dock itself should be constructed in Spain.

The system of floating depositing docks is now well known in this country through the dock of that type that was erected at Barrow some ten years ago, and has from that time been successfully working, and by the example which, originally erected at Nicolaieff, was later on removed to Sebastopol, where it now lies. It may, however, be useful to again shortly describe the general principle. The depositing dock is a float-



DEPOSITING DOCK FOR SIX THOUSAND TON SHIPS, BARCELONA—END VIEW.

ing dock similar in shape to the well-known offshore docks of the same firm, that is to say, it has only one vertical side, stability being obtained by attaching the dock by means of a parallel ruler attachment to a floating outrigger. The pontoon, or body of the dock, instead of being a continuous box running the whole length of the dock, is built up of separate pontoons in the shape of fingers projecting from the single side. Similar fingers, but built up of piles, are erected along the foreshore, and when the vessel has been raised on the dock in the usual way, the whole dock, with the vessel on it, is warped in to the grid, the fingers of the dock fitting between those of the grid. The dock is then lowered, when the vessel naturally remains deposited high and dry on the grid, the dock itself being then withdrawn, when it is ready to pick up other ships if required.

It will be seen, therefore, that the construction of each length of grid is equivalent to doubling the capacity of the dock, as the mere raising and depositing of the vessel is a short operation, and two or three vessels can easily be dealt with in the course of the day. Such a dock is specially applicable to the port of Barcelona; first, because of the absence of tide, which enables the dock to deposit vessels at all hours; and secondly, because there being no dock of any kind at Barcelona, in spite of the enormous amount of shipping which yearly visits that port, there is far more work than any single dock could cope with, and indeed, the original project for dry or graving docks comprised no less than three of these costly works, the cost of a single one of which would have been higher than that of the depositing dock.

The present dock is to be constructed in three pieces, two of which are to be rigidly bolted together, and will in practice always work together, being only disconnected when it is required to dock either of them for the purpose of getting at their under water portions, for it is an advantage of these one-sided types of docks that they can at any time with only the slightest preparation dock themselves, so that their underwater portions can be as carefully looked after as those of a ship. This power naturally allows the life of these structures to be indefinitely prolonged, and, indeed, if properly looked after, they may be considered as long lived a form of structure as even a graving dock. The combined length of the two sections is sufficient to deal with ships up to about 300 ft. long, and their lifting power is sufficient to take vessels up to a dead weight of 4,000 tons. The third section will generally work separately, being destined to deal with the small and numerous type of coasting craft, but it is so arranged that it can at the shortest notice be brought round and attached to the first two sections, forming a dock of a lifting power of 6,000 tons, and capable of taking vessels up to 400 ft. long. It is computed that this dock will more than suffice for the present type of craft that frequents this port, but at the same time it is a point in favor of this kind of dock that if ever the size of vessels should increase beyond its capabilities, it is an extremely easy matter to construct further sections of any length, which can be built apart and then inserted in the existing dock without interrupting its functions beyond the few hours necessary to make the joints.

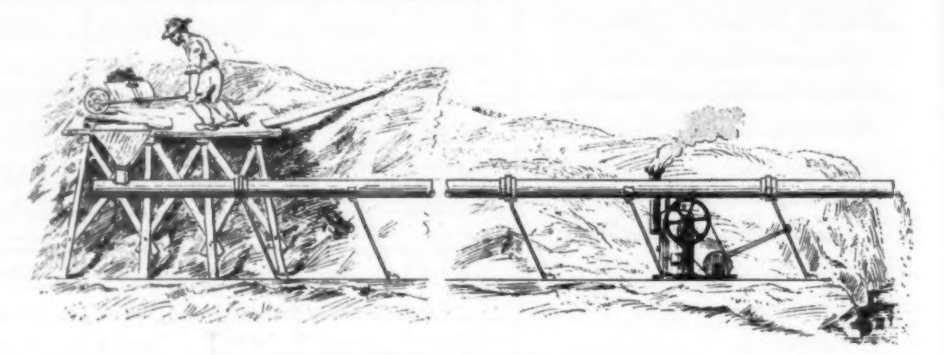
The present dock is to be placed in a sort of basin in the outer port of Barcelona, and the depositing stages will be placed along two sides of this basin, each row having a length of 650 ft. The dock is to be moored in the middle of the basin, and is in two sections, as described, placed back to back, with their pontoons facing the grids. The grids themselves will be of two forms of construction. Those facing the small section will be comparatively light, as they are intended to receive the smaller classes of vessels; but those opposite to the double section will be of the strongest construction, and capable of receiving vessels up to a dead weight of 6,000 tons.

We give an end elevation of the dock, showing the general arrangements of the pumps, engines and other parts. It will also be provided with its own hauling engines and gear for traversing the different sections either together or separately from their moorings to all parts of the depositing grids, the engine power being sufficient to perform the whole operation of lowering the dock, lifting the vessel, and depositing the same on the grid within a period of four hours.

As regards all minor fittings, cleats, bollards, etc., the dock will be most fully provided; and it will be, besides, fitted with Messrs. Clark and Standfield's mechanical side and bilge shores, by the use of which the berthing of a ship is much expedited. The dock generally may be considered as being fitted with all modern requirements, and when completed, will form a most useful addition to the port of Barcelona. Considering the facilities afforded by these floating docks and depositing docks, and the perfect non-straining support they give to ships carried by them, it is remarkable that they are not more numerous.—The Engineer.

A NOVEL CONVEYOR.

CONVEYORS of materials to a distance have now come into general use. Some consist of an endless belt, as for grain elevators, and others of tubes in which the material mixed with water is carried along by gravity. We figure herewith a new and curious system that is based solely upon inertia. It is the



THE KREISS CONVEYOR.

Kreiss conveyor, constructed in France by the Davidsen establishment.

Let us take a cylindrical iron plate tube, and sustain it at a distance above the ground by rods of flat iron, which are supported by a frame wide enough to assure the stable equilibrium of the system. In reality these rods are inclined springs riveted at the upper part to collars and supports.

It will be understood that if we give the tube a tractive movement toward the right, the springs will tend afterward to carry it toward the left. If a pebble is placed in the interior, it will first be carried along to the right and then, while the tube is effecting its backward motion, will remain in place by virtue of the velocity acquired and of inertia, and will even advance a little bit during the retrograde travel of the tube. Upon the whole, after the end of this double motion, the pebble will have moved forward a certain distance toward the right, and, the to and fro motion being repeated a sufficient number of times, it will have made its exit from the right extremity after entering at the left.

Excavated material and substances of all kinds may thus be easily carried in the same way. Upon two crosspieces are installed two cast iron cheeks that support a crank shaft, to which are keyed a pulley and a flywheel. The shaft, through an eccentric, actuates a connecting rod which is attached to one of the supporting collars. Let us cause the shaft to revolve by means of a steam engine or otherwise, and the tube will take on precisely the alternating motion desirable, from left to right, and then from right to left.

Consequently, if the tube be provided at its left with a hopper, the material thrown into it will move along throughout the tube and be discharged at the free extremity.

The principle is very original, and the apparatus may be used for the carriage of the most diverse materials, from coal to grain and earth. It has the advantage of being of very simple construction and appears to require but little motive power. It may be charged at several points, if desired; there is no escape of dust, and it is completely emptied when one ceases to charge it before arresting the running of it.—La Nature.

THE MANUFACTURE OF ACETYLENE.

ACETYLENE gas was studied for the first time in 1862, by Berthelot, who determined its composition and its principal properties. He at the same time made a synthesis of it and gave its formula, which, translated into chemical symbols, is C_2H_2.

Since that epoch, several well known chemists have, through their observations, completed Berthelot's study. In Germany, Woehler, in the decomposition of water by impure calcium carbide, effected with great trouble, ascertained the production of a gas whose principal properties assimilated it to that of Berthelot. In England, Travers and Winkler likewise pushed their studies in this direction, but without any result. In France, Mr. Maquenne in 1892 succeeded in producing a gaseous mixture of hydrogen and impure acetylene by means of an amorphous carbide. These different productions of acetylene, and, in particular, that derived from the decomposition of cupreous acetylide, presented many difficulties. There were obtained in laboratories, moreover, a gas whose very impurities led opinions astray. It was manipulated only with great precaution, as there was attributed to it not only considerable toxic power, but also the formation of dangerous explosives. Such formidable properties were fortunately in great part visionary.

In 1894, Mr. Moissan produced in his electric furnace a well defined and crystallized calcium carbide of the formula CaC_2, whose composition and properties were fixed by him. This carbide decomposed water in giving rise to pure acetylene gas, C_2H_2.

Toward this epoch Mr. Bullier was studying the industrial production of calcium carbide, CaC_2, and investigating its different applications. He found that the theoretic rendering of the decomposition of one kilogramme of calcium carbide was about 350 liters. The improvements introduced into its manufacture permit of obtaining it in a sufficient state of purity to

allow this figure of 350 liters to be sensibly approached industrially.

The applications of acetylene are numerous, and some of them permit at this moment of foreseeing the importance of the discovery of our scientists. We are going to occupy ourselves at present with one of its principal properties; we refer to its application as an illuminant.

Mr. Bullier, whose experimental laboratory at 31 Buffon Street we have seen, is occupying himself specially with this question. While making his photometric experiments in a dark room adjoining his laboratory, he has desired to be able to prove through a small installation the facility and advantage of the use of the new gas as an illuminating agent.

Acetylene owes its great illuminating power to its richness in carbon, but this very richness renders necessary the use of burners that are peculiar either by their arrangement or at least by the small size of their orifice. In fact, the gas burning with a certain thickness of flame does not furnish enough heat to raise all the particles of carbon to incandescence, and there is therefore a production of lamp black. On the contrary, if we employ flames produced by butterfly burners having very narrow slits, or, better, by the commingling of two sufficiently small jets, the surface of contact with the surrounding air will be proportionally increased, the gas will dilute its excess of carbon in the necessary quantity of air, and the flame, ceasing to be fuliginous, will give its maximum of intensity.

In order to remedy this inconvenience, it has occurred to Mr. Bullier to dilute his gas in the gasometer itself. To this effect, he employs an inert gas, the sole action of which is to form with the acetylene a mixture in which all the carbon is raised to incandescence. The gas that he has selected is nitrogen, the proportion of which, it is evident, should increase in the mixtures at the same time as do the orifices of the burners that it is desired to employ.

The mixtures used by Mr. Bullier are ordinarily those that contain from 40 to 50 per cent. of nitrogen. They permit him to employ the ordinary burners in use, either butterfly ones or those with three apertures, styled "Manchester."

The following is a brief description of Mr. Bullier's installation: At the rear of the laboratory there stands to the right the acetylene generator, A, and to the left the nitrogen furnace, F.

The generator consists of a simple cast iron cylinder having a movable cover surmounted by a pressure gage. In this cylinder there is placed a support—a basket designed to receive the calcium carbide. At the lower part a water inlet corresponds to a small reservoir, R, which serves at once as a source of water and a pressure regulator. It suffices, in fact, when one wishes to moderate the production of the gas, to leave open the cock of communication with the reservoir, when the pressure increasing in the generator with the attack, the water will be forced and the disengagement will be arrested. At the upper part of the generator there is an iron tube, T, that serves as an exit for the gas, and that traverses in spiral form a small reservoir of cold water, P, and then runs under the gasometer, C, designed to collect the acetylene.

To the left the nitrogen furnace, F, is traversed by a series of iron tubes containing copper wire. A current of air forced into these tubes by means of a gasometer, G, forming a blower, oxidizes at a red heat the copper with which it is in contact, and the nitrogen, upon its exit, is collected in a special gasometer, S. This nitrogen still contains a little carbonic acid, which, however, in nowise interferes with the use to which it is to be put.

In the middle ground there are four tanks, in which move the gasometers of a capacity of about two cubic meters. These gasometers, directed by wooden uprights, MM, are supported by cords that run over pulleys, PP. From the extremities of these cords are suspended weights that may be varied at will, according to the pressure to be obtained.

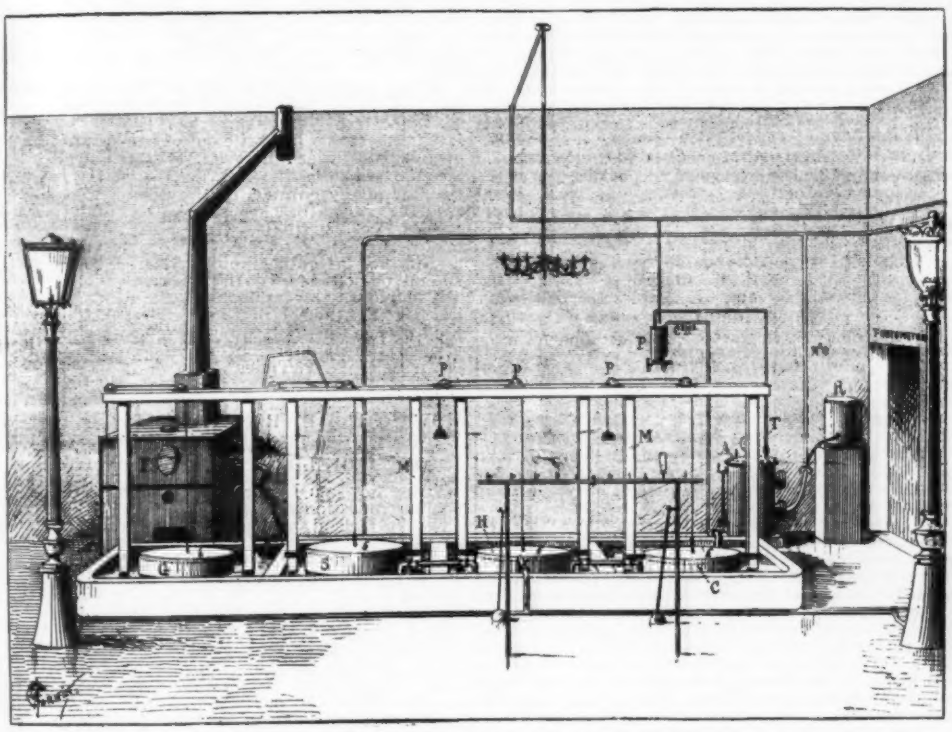
To the right is the acetylene gasometer, C, to the left the gasometer, G, serving as a blower; next to it the nitrogen gasometer, S, and finally the gasometer, H, in which the mixture is made in the desired proportions.

A system of iron piping connects the gasometers with each other so that different mixtures can be easily made.

In the foreground there are two posts, one of them surmounted by a common city lamp and the other by a five-burner lamp of the style called "Quatre-Septembre."

An experimental row of burners is placed between the two lamp posts, half of which are supplied with city coal gas and half with gas from the gasometer, H. A chandelier with six branches completes the installation.

The doors being closed, a relative darkness pervades the laboratory, and the eye, after receiving the impression of the light furnished by the coal gas and by the incandescence of the Auer "manchon," is vividly impressed with the brilliancy of the radiations of the little flame of acetylene. The flames of the coal gas detach themselves like dull patches from the luminous background, while the acetylene burners search out with their rays the smallest nooks of the laboratory.—La Revue Technique.



BULLIER'S LABORATORY APPARATUS FOR THE MANUFACTURE OF ACETYLENE.

ON THE SENSITIZING ACTION OF DYES ON GELATINO-BROMIDE PLATES.*

(Abstract.)

By C. H. BOTHAMLEY, F.I.C., F.C.S.

ALTHOUGH many dyes have been examined since H. W. Vogel's discovery in 1873, very few of them exert any marked effect in making gelatino-bromide plates sensitive to the less refrangible rays of the spectrum. Only cyanin and the dyes of the eosin group (including the rhodamines), with perhaps malachite green, alzarin blue, and chrysoidine, exert any practically useful effect.

The main points established by previous observers may be summarized as follows:

(1) All the dyes that act as sensitizers are readily affected by light when in contact with paper, fabrics, etc.; (2) in order that a dye may act as a sensitizer it must have the power of entering into intimate union with silver bromide, forming a kind of lake; and (3) it must show a strong absorption band for the particular rays for which it is to sensitize. It is important to observe that the converse of these statements is not necessarily true, since several dyes that have all these properties show no appreciable sensitizing action.

Experiments by Dr. E. Vogel on the rate of fading and the sensitizing action of the eosin dyes led him to the conclusion that the order of sensitizing effect coincides with the order of fading when the dyes are exposed to light. The order in which he places the dyes does not, however, correspond with the order of fading as observed in dyed fabrics, and the experimental method that he used is open to criticism.

The author's observations on the fading of the various sensitizers when exposed to light in contact with gelatin alone led him to the conclusion that, although all the sensitizers are readily affected by light, the order of sensitizing effect does not necessarily correspond with the order of fading, whether the dyes belong to the same chemical group or not.

There are two chief hypotheses as to the mode in which the dyes act, namely:

(1) The view held by Abney, that the dye itself is oxidized by the action of light, the oxidation product remaining in contact with the silver bromide; and when the plate is treated with the developer, the latter and the oxidation product, acting simultaneously on the silver bromide, bring about its reduction; and (2) the view first definitely formulated by Eder and indorsed by Vogel, namely, that the energy absorbed by the dyed silver bromide is partially used up in bringing about the chemical decomposition of the silver bromide, instead of being almost entirely converted into heat as when absorbed by the dye alone.

The author has found that the less refrangible rays will produce a photographic image on the sensitized gelatino-bromide plates when they are immersed in powerful reducing solutions, such as a mixture of sodium sulphite and pyrogallol. This holds good for cyanin, the eosin dyes, the rhodamines, and quinoline red, whether the sensitizer has been added to the emulsion or has been applied to the plate in the form of a bath. It is therefore impossible to attribute the sensitizing effect to any intermediate oxidation of the dye.

Experiments with various reagents, such as potassium bromide, potassium dichromate, mercuric chloride, and dilute hydrogen peroxide, seem to show that the chemical nature of the latent image produced by the less refrangible rays on the specially sensitized plates is precisely the same as that of the latent image produced by the more refrangible rays in the ordinary way.

Further proof in the same direction is afforded by the fact that the effect of the sensitizers extends to the production of a visible effect by the prolonged action of light.

The balance of evidence is therefore greatly in favor of the view that the dye absorbs the particular groups of rays, and, in some way which is not at all clear, hands on the energy to the silver bromide with which it is intimately associated, and which is thereby decomposed.

* Read before the British Association, Section B, Ipswich meeting, 1895.

WHO IS ENTITLED TO THE NAME INVENTOR?

By T. W. GRAHAM.

INVENTIONS are not nearly as numerous as most people imagine. In fact, real inventions, like angels' visits, are few and far between. Not one out of a thousand patents granted are for inventions in the true sense of the word, and yet we are wont to dignify every patented article as an invention and the patentee as an inventor. If inventions alone were patentable, it is doubtful if a hundred patents a year would be issued in this country. The most valuable machines in every department of mechanical industry are imitations or improvements of some previous device. The germs planted by inventors are nursed, cultured and expanded in a thousand eager brains until they blossom into perfection. To illustrate this, let any one familiar with the history of milling make up a list of the machines in use in mills to day that can be called inventions. Roller mills are certainly not in the list, for we copied the idea of the roll itself, of corrugations and differential, and the main principle of adjustments, from Europe. We have simply perfected the details of crude machinery turned out by the inventor. The Smith purifier was merely the addition of a traveling brush to a European device. The brush itself was not novel except in its application to a sieve with air passing through it, and the credit of the brush idea has always been a matter of dispute. No one knows who constructed the first round reel, and the present grain cleaning machinery represents the evolution of at least a century. Even the plan sifter is merely an improvement on an old principle of bolting coarse products, and the modern dust collector is simply a condensed dust room. It is doubtful if a machine embodying an original invention can be found in practical operation in a first class modern flour mill in the United States to-day. We must search among the neglected and tumble down relics of the past to find the inventions which are responsible for present developments. The question then naturally arises, What is an invention, and who is entitled to the name inventor? These questions can best be answered by an illustration—Columbus discovered America, or at least he is given the credit therefor, and to serve as an illustration let his claim be admitted. Thousands of men since then have spent the best part of their lives exploring the continent Columbus discovered, and part of it still remains unknown. Every explorer has added something to the knowledge gained by his predecessors, and all of them probably learned more than Columbus ever knew about the continent which he discovered. This, however, does not detract from his credit. It was necessary to discover the continent before it could be explored. Those who have measured its mountains, surveyed its plains, traced its rivers, coasted its lakes, sounded its harbors, bounded its coasts, pioneered its forests, and revealed its mineral wealth to the world, all owe to the original discovery the opportunity which has brought them wealth or fame.

So it is with the inventor. A hitherto unknown law or principle is brought into practical use by some inspiration of genius or fortunate accident or combination of circumstances which the inventor is the first to perceive and apply. Usually his creations are crude and results imperfect, but however imperfect or fruitless the results, they are the necessary prelude to the triumphant harmony which subsequent brains and hands evolve therefrom. Whoever first produced a practical plan for utilizing the power of steam was an inventor. His discovery has lightened the labors and greatly multiplied man's power to produce wealth and satisfy his needs. Hundreds of explorers since then have added and are still adding their mite to the knowledge thus obtained. The crude devices used by Watt and Stephenson a century ago would not be tolerated now in a backwoods sawmill, and yet they contained the germ out of which have grown all the triumphs of modern engine construction—the majestic Corliss, the double, triple, and quadruple compounds, with their excellent steam economy, and the numerous high speed types whose dizzy whirl would frighten the old time engineer out of his wits.

Thomas Edison is an example of one who has gained a world wide reputation as an inventor, but it is doubtful if his achievements entitle him to be so classed. He is more properly an explorer who has penetrated the labyrinths of a discovered field and with mathematical precision worked out the various problems which have startled the world. The inventor has neither precedents nor rules for a guide. Out of chaos he

evolves something of benefit to man and cries "Eureka!" as he bids the world gaze on his creation.

To invent is to originate something previously unknown. Edison may have done this in a few instances, but most of his work has been in the line of development. The same can be said of nearly all the names whose fame is recorded by mechanical triumphs. Real inventors seldom succeed in gaining recognition or pecuniary success. Ofttimes they have but a faint conception of the magnitude or value of their discoveries. More practical and energetic minds grasp the rewards and ofttimes the credit, but neither poverty nor lack of appreciation can rob the inventor of the thrilling, enduring satisfaction which nature grants to those who seek for truth and find it either in the realm of physics or economics. Man's ingratitude may wound, but Nature kindly soothes and heals the wounds of those who love her, and the keen delight of those who court her fellowship cannot be measured in sordid dollars or comprehended by those who worship at the shrine of Mammon.

The inventor is the pilot of progress. Explorers follow to build the bridges, tunnel the mountains and grade the highways over which humanity marches onward and upward to a higher and grander civilization. Inventors and explorers are both necessary and almost equally important factors in human development.—Milling.

USEFUL HINTS FOR WHEELERS.

SITTING on the piazza of a hotel, and watching the whirling flight of the thousands of cyclers as they stream along the boulevard, every observer is constrained to notice the great variety of positions. Now passes a staid merchant or minister, in the fifth or sixth Shakespearean stage of life, sitting the saddle with a "swayback" pose and clinging to the handle bars as if to save himself from falling upon the rear wheel.

Next may come a very new woman, bloomer-clad, on a diamond frame mount, who leans low over a pair of ram's horn bars, but keeps her head perked up, like a turtle on a chip; she looks like no other creature that soars the air, that travels the earth, or inhabits the seas; hers is a figure utterly unique. Then follows the thing she apes, the genuine scorcher, who keeps in racing trim by road work, reckless of the annoyance and danger to others; he has the true businesslike hump of the back, like that of an angry cat; his head is bowed with chin to breast, so that he can see if the ground smokes where his front wheel passes, and quite likely he is arrayed in racing tights, which would be vulgar on the vaudeville stage.

After him, in the swiftly moving procession, is the austere lady, who wrestles with the young ideas that rise from public school forms; viewing her there is no escape from the conclusion that she has no joints above the hips, for she sits rigid and straight as a blackboard pointer, though infinitely less graceful, and her reach to the handle bar is the same as it is to the side edges of her desk when pronouncing a bad mark sentence upon a culprit. So the aspect of the cycling pageant shifts until the least keen observer can tally off a score of different attitudes. Reflection upon the phenomenon teaches that, with a camera, the pose of every rider would be shown to have some variations from the type to which it belongs, so that, in the fineness of fact, no two positions are exactly the same.

All this is true, and there are as many different ways of sitting on a wheel as there are riders. It is reasonable to suppose that each individual assumes the pose which he or she believes to be most comfortable and advantageous. Yet the anatomy and physiology of the riders is homogeneous, and the commonest order of reasoning declares that they cannot all be correct. However personal peculiarities may vary, such widely divergent attitudes must cause different distributions of work among the muscles, and the whole hygienic effect of the exercise cannot be the same. Out of this emerges the question:

"Is there any ideal cycling position—any pose which should be a criterion to which all riders should conform as nearly as their peculiarities of physique will permit?"

Such a position must combine healthfulness with a vantage of power and a harmonious distribution of exertion. The hygienic and mechanical considerations must be brought to balance. Occasionally, too rarely, one sees in the throng of cyclers, just as in an equestrian company, some man or woman who looms out distinctly because he or she sits gracefully, looks comfortable, and conveys the impression of riding easily. This effect is never created by a cyclist sitting bolt upright, nor by one humped up and bent over. In the tan bark schools the instructor teaches that "position is everything." It is equally true with regard to cycles, but it is not so taught in the academies. First to be considered is the adjustment of seat and reach, which makes the rest of the pose possible. There is mechanical and physiological conformance necessary in the machine itself. Many experts and physically strong riders find, after a whole day's riding, that they experience greater soreness in certain joints and muscles than companions who are less vigorous. It is because their bicycles, though perhaps of highest grade in workmanship, are imperfectly proportioned. There are anatomical reasons for the distances, and for the angles between seat, cranks, and handle bars. Manufacturers nowadays are realizing this, and are paying more attention to the details indicated than formerly, and all of them approximate the true lines. In machines where the proportions are not good the variety of saddles, the T-shaped saddle posts, and the different kinds of bars offered for selection will enable riders to make the proper adjustment.

Usually riders have the saddle too far forward or too far back for the thrust necessitated by the cranks. When the thrust of the foot goes behind the hip, there is undue strain upon the muscles on the under side of the thigh; when it goes too far forward, the muscles on top of the thigh and those in the groin suffer. Where the crank is horizontal, pointing backward, the foot should be in such a position that a plumb line drawn from the hip joint to the ground would bisect the ankle. When this test is made and found true, the saddle and pedals are in proper adjustment, so far as bringing the rider over his work is concerned. Next the elevation must be fixed to a nicety. The pedal in its downward extension should not draw the leg out to its utmost reach. Neither should the saddle be so low as to leave any decided bend at the knee joint when the leg is extended. A slight reserve should be left in the leg, sufficient to enable the rider to rise an inch from the saddle by standing on the lowered pedal. A good test for the proper reach in height is made by taking the foot from the top of the pedal and putting it underneath, so that the toe or top of the shoe stretches along the underside of the pedal and touches it evenly. Raise the saddle till you can barely do this. In raising the saddle it will have to be moved forward a trifle, or the other relation to the pedal will change, because of the slant in the perch tube and saddle post.

Getting this proper adjustment of relations between saddle and pedals is the most important thing to every person who rides a wheel. It removes many of the legitimate objections that physicians have been able to make. In the old high wheels, where the thrust of the pedals was away forward from the saddle, there was an acknowledged danger of hernia. Some makers have not yet brought the seat far enough over the pedals, while others, in trying to remedy the fault, have exceeded the limits and put the seat too far forward. To thrust too far behind is equally as liable to strain the rider as the forward pull on the muscles. The test of the line from the hip joint to the ground is reliable, and should be universally employed.

Now as to the carriage of the body in the saddle:

There should be perfect ease and naturalness of poise, and this cannot be had in a perfectly upright position. There is the same reason for a forward inclination of the body in riding as in running and walking. It is necessary for power and perfect poise. The doubled over position of the scorcher is all right for racing. In that way the rider gets the utmost push on the pedals, and, by bending his head low, he offers the least resistance to the wind. For ordinary road riding, though, the scorcher position is as absurd as is the bolt upright or "swayback" pose. Racing is the excess of the sport and the abuse of the exercise. The ideal position is one of leaning forward from the hips, not bending, but leaning. The proper angle is about 25° or 30° from the perpendicular, with the arms dropping downward and forward to the bars. The arms should be straight. The back should not be bent forward in the least, but, per contra, should be hollowed. The abdomen should be drawn in, the chest expanded, and the head erect. In brief, the carriage of the torso should be precisely the military position which is taught to the "awkward squad."

To take this position and utilize it to the utmost, the bars should be almost level with the saddle, for riders of average height and reach. Others may require them a little higher. The saddle should be tilted a trifle forward with the peak depressed, but the degree of the dip should be so slight as to be appreciable more to the feeling of the rider when in it than to the eye. This throws the body forward so that the pose described is natural and easy. It enables the rider to get some of the advantage of his weight in his pedaling, which is as it should be, for the action is perfectly analogous to running. Moreover, the position given is one that saves the machine. When riding in this manner, the rider's weight is distributed between the seat, pedals, and handle bars. It is an abuse of a wheel for a rider to sit like a sack of meal and keep a dead weight right on the saddle and diagonal tube.

The trouble with many in adopting this pose will be the position of the saddle. It is unfortunately true that no saddle that is anatomically perfect is yet on the market. That it will come in time is certain. Very many riders find that they are most comfortable with the peak of the saddle tilted upward. This is often only a fancy, due to the fact that they have not given the other pose a just trial. The forward position keeps one pedaling, and at first seems to be more work, but in reality the back lolling position strains the leg muscles much more. An analogy to this point of seeming and fact is the position men take when sitting in chairs. The persons who hold themselves up are healthier and can sit longer without aching than those who slump into a heap. Those who sit all relaxed do it because they think themselves more comfortable, but are mistaken, just as are those who go for a ten mile run on wheel and think they should sit back as they would in a rocking chair. If your wrists and shoulders do not tire almost as much as your legs, you are not taking your exercise awheel properly.

On the subject of saddles it is difficult to give advice that has general value. Saddles are much like shoes, in the respect that no one can tell from looking at them whether they will be comfortable. Experiment is the only thing in this line, and it should be borne in mind that even though you get a good fit, a new saddle, like new shoes again, must be broken in. It will be stiff and uncomfortable for a few days at any rate. One point in this relation will bear emphasis, which is that a saddle with easy springs is a snare and a delusion. In the long run, it will cause much more soreness than a hard seat. The fit is of more importance than the spring, from the point of comfort. When a saddle is springy it gives on one side every time the leg makes a thrust, and this causes chafing. When the saddle yields with the leg thrust there is also lost motion, and much of the power put forth is wasted. No man can push very hard in any way if he is using for a brace a cushion that yields instead of resisting. Besides all this, springy saddles get very soft and saggy with use, and then they cause no end of soreness.

If riders would study such points as are here touched upon and seek to attain the hygienic position they would find still greater fascination in the sport, and much less occasion would be afforded for criticism of cramped and awkward poses, and for complaint at the injuriousness of the exercise.

After getting the proper position, the next thing is to acquire the knack of pedaling evenly. This is something that comparatively few bicyclists do, and many who have been riding for several years do not know their fault in this respect. They wonder why they have more trouble in keeping steady and riding a narrow path than others. It is because their alternate pushes upon the pedals are not even. Every stroke upon one pedal tends to drive the wheel to one side unless it is immediately caught by a thrust of equal force upon the opposite side. Oarsmen have the same difficulty to confront because they are stronger in one arm than in the other. It is also a fact that almost every person has one leg longer than the other, or, if this is not the case, one is stronger. Cyclists do not think of these things, it would seem. If they did, they would begin to correct their uneven pedaling by keeping their minds upon it and equalizing the thrusts of their feet. A wheel, when evenly pedaled, will run in a straight line without any steering of the handle bars and without a bit of wobbling, whereas very few riders indeed can travel far without touching the bars. A good way to acquire even pedaling is to begin by seeing with how little touch upon the bars you can ride, relaxing your hold gradually till you have only a finger tip on the steering apparatus. By persevering at this you will soon be able to ride with your arms folded, and when you can you have learned to pedal evenly.

Not infrequently one can hear a rider complaining that his wheel runs hard and that he can discover no cause for it, when the very obvious cause is that the frame is out of line. Frames often are slightly sprung by turning in sandy places or by a fall. Sometimes the irregularity can be detected by the eye, but if it cannot be seen, then the wheels and sprockets should be tested to see if they are in line. The front wheel and rear one should track, and if they are set true between the forks and the frame is straight, they will do so. If your wheels are both centered in their forks, are as far from one side as the other, then you can try them for the trueness of frame very easily. Turn the wheel upside down, getting the handle bars straight, and set both wheels spinning. Then, with a piece of string long enough to reach from one end of the machine to the other, see if it can be stretched taut and held so as to be just a little above the center of the tires; or better still, because it does not allow for deception by irregular tires, is to take two strings and hold one against each side of the rim. If the spinning wheels bring the rims in constant contact with the strings on both sides, the wheels are true.

To ascertain whether or not your sprockets are in line with each other, a string can be used simply and effectively. Take off the chain, and, making a loop in one end of the string, put it over a tooth of the front sprocket, then draw it taut to the rear sprocket and hold so as to see if every tooth of the smaller sprocket will touch the string. If the rear sprocket is true, as it is apt to be, you can then test the front one similarly.

If the sprockets or wheels are true to themselves, but out of line with respect to each other, it means that your frame is sprung.

A frame that is but little out of true can be straightened by the owner if he exercises tact and care. Take a square stick of soft wood, notched so as to receive the tubing of the frame, and lay the cycle upon it as near the bottom bracket as possible, and then bend the frame gently till it is true again. Sometimes it may be necessary to remove the axle and sprocket, and always before beginning this trick the rear wheel should be bolted fast to the rear forks.

A simple way of easing up a chain that has a tight link is to lay the bolt of the troublesome link over the hollow of a nut and tap it gently with a hammer or wrench, beating first one end and next the other end of the bolt.—N. Y. Times.

HOW TO LEARN TO RIDE A WHEEL WITHOUT THE AID OF AN INSTRUCTOR OR A HELPER.

"BUT how am I ever going to learn to ride it?" is the first question the would-be cyclist is liable to ask the kind friend who advises him to get a wheel. Then the kind friend aforesaid usually tells the would-be one to hie himself to a riding academy and there have the young cycling idea taught to scoot. The advice is good, in fact, it is the very best, but supposing the advisee has the misfortune to live where riding academies are not as plentiful as they are in the larger cities, how, then, can he quickest learn to ride? Perhaps the following may aid him in this:

Get an old wheel, if possible; if not, take your new mount, adjust the saddle low enough for the ground to be easily reached by your feet while seated in the saddle. Remove the pedals, choose a level bit of road, get astride the saddle, push the wheel along till it has headway, then raise your feet from the ground, maintaining your balance until the machine finally compels you to place one or both of your feet upon the ground. Repeat this until you have learned to balance yourself and have acquired the confidence begotten thereby.

You will find it necessary in learning to ride to unlearn much of your previously acquired knowledge regarding the art of balancing. The whole secret of wheel balance lies in doing just the reverse from what you feel inclined to do, namely, when the machine begins to incline toward the left, turn the steering wheel to the left; if you are falling toward the right, turn to the right. Once you have learned this so as to do it unconsciously, you are more than half way through your cycling novitiate. Endeavor to avoid sudden and violent pulls at your handle bar at this stage of learning.

When able to balance yourself on the machine for as great a distance as the wheel will run from the momentum given it by a shove from your feet, find a smooth road with a slight down grade and practice balancing for longer distances. Begin close to the foot of the grade, and gradually take the machine nearer and nearer the top, as each succeeding trial gives you confidence. Steer as straight always as you can. After a while practice balancing on the step. Place your left foot on the step, give a slight shove off down the incline with your right foot, raise yourself on the step, resting all your weight on the left foot, remaining in that position as long as the motion of the wheel keeps it upright.

When you can balance yourself with some confidence, both in the saddle and on the step, start down the incline on the step, and while in motion glide smoothly into the saddle. The length of time required by the beginner to learn the art of balancing varies considerably, but usually it can be fairly acquired in three or four lessons of an hour or two each, and with ordinary caution no falls need be experienced.

Having reached this stage, replace the pedals, raise

the saddle a trifle, still, however, not so high that your toes cannot touch the ground, start down the incline as in previous practice, and while keeping your attention chiefly on the steering and balancing, feel cautiously for the revolving pedals beneath your feet. At first try only to follow them around, and take your feet off at the first decided symptom of wobbling. After a little practice at this, begin to press gently on each pedal as it goes down, and you will soon learn to propel yourself.

This advice, of course, is intended for the man who must make of his novitiate a game of cycling solitaire. It is far better, and his learning will be speedier and more pleasant, if the friend is himself a rider; then his company will be doubly valuable to the beginner in encouraging him in his efforts. But no man, old or young, can fail to learn to ride if he proceeds along the lines above and perseveres.

THE SCIENCE OF EXAMINING.

By PETER T. AUSTEN, Ph.D., F.C.S.

MUCH severe criticism is being directed against examinations, and much of it is timely and fully deserved. And yet when the criticisms are carefully considered they appear to be directed not so much against examinations as a method in education as against certain forms of examinations which are very prevalent, and which certainly do not show anything more than evanescent memorization, adroitness, or trickiness on the part of the student. No one will deny, however, that much of actual life is a kind of examination, and that we are being continually pressed to solve problems of all kinds, apply knowledge, and in general to act, and that on the success of our efforts will depend the positions we will attain, or at least maintain. There seems to be no reason why examinations should not be made an extremely important part of education, instead of being, as I fear they often are, an unmitigated nuisance to both student and teacher, a bone for the pedagogical critics continually to snarl over, and, when all is done, to be of no real use to either teacher or student, and to show nothing as to the real nature of the teaching done and the mental development of the student.

For the teacher who teaches from love of teaching, and who knows that successful teaching calls for the application of psychological principles far more than is generally supposed, there is a peculiar fascination in an examination paper. An examination may be made a test of the contents, capacity, quality, and action of a mind under defined conditions; but the paper must be a good one; I do not refer to the work of an inexperienced hand. The idea seems to be prevalent that any one can write an examination paper. This is a great mistake. The elaboration of a paper that will really test not only the contents of the mind, but also its different functions as developed by a particular study under the guidance of a particular teacher, requires experience and ability. It is true that a man may be a good teacher and a poor examiner, but this usually arises from a lack of attention to the science and art of examining. My experience in this branch of pedagogical science leads me to believe that there are not very many really good examiners, and that the average examinations do not test the minds of the students as they ought to be tested. The average examination calls mainly for an exercise of memory, and for some proof that the student understands the matter he has studied. No man values the faculty of memory more highly than I do, or requires a better understanding of a given subject. But memory and mere understanding are only the foundations of education. More than this is called for. Some examinations require skill in observation, others accurate definition; while others bristle with problems. Some call for knowledge in which the teacher is weak. Almost every pedagogic earmark may be found in examination papers, but rarely is the paper constructed on such a plan that it tests not only the quality and quantity of knowledge in the mind, but also the various workings of the mind, and ascertains what the mind can do when set in action by the particular subject.

In my own specialty of chemistry there is an excellent opportunity for examination papers which may test the mind qualitatively and quantitatively, and probe both absorptive and productive powers. I have always taken a great interest in working out examination papers and in studying the minds as they appear in the answers. I am accustomed to work out questions under various heads. The following example will serve to indicate my meaning, and may also encourage others to experiment in examinational science; and I think that the method will be found so interesting that the investigation will not be hastily dropped. I should add that in the examination paper as given to the students the questions are mixed up, so that the classifications given as follows do not appear.

QUESTIONS FOR TESTING:

Memory.—(1) Give a brief history of oxygen. (2) Outline the theory of phlogiston. (3) What are "copperas," "bluestone," "tincal"?

Accuracy of Definition.—(4) State concisely the laws of Dalton, Charles, Mariotte, and Avogadro. (5) Define a mechanical mixture. (6) Define an element.

Observation of Experimentally Demonstrated Facts.*—(7) Describe and sketch an apparatus for producing acetylene from calcium carbide, and explain the working of it. (8) Describe and sketch the combustion of nitric acid in iodohydric acid.

Accuracy of Detail.—(9) Explain with the aid of sketches the reduction of hot cupric oxide by hydrogen, heating the oxide in a combustion furnace and preparing the hydrogen in a Kipp generator.† (10) Make a sketch of a section of Pepy gasometer, and explain how the apparatus works.

Acquaintance with the Properties of Matter.—(11) Describe the properties and chemical behavior of nitrogen, sulphur, zinc, silica, and iodine.

Retention of Oral Instruction.—(12) Explain the contamination of water by sewage. (13) Describe the process for making open hearth steel.

The Faculty of Comparison.—(14) State similarities and differences between the properties of oxygen and hydrogen. (15) What substances resemble lead sulphide in color and solubility in nitric acid?

Lucidity of Statement.—(16) Describe minutely and without sketches the apparatus and method of preparing phosphine. (17) Prove by analysis of stibine by volume, that the molecule of antimony is tetratomic.

Recognition of Substances.—(18) A yellowish green gas with a suffocating odor. What may it be? (19) A colorless gas, very soluble in water, gives white fumes with hydrochloric acid. What may it be? (20) A white powder, insoluble in water; heated with concentrated nitric acid it evolves red fumes and yields a solution, which, when excess of acid is evaporated off, and it is diluted with water, yields a precipitate which is insoluble in concentrated nitric acid. What may this white substance be? (21) A chemist wishes to fill a jar with red liquid. What substance may he use?

The Ability to Observe.—(22) Give four examples of chemical change which you observe in this room. (23) Describe an ordinary red building brick, stating dimensions and properties of surface, weight, fracture, etc. (24) Water expands on freezing. Give five examples of results caused by this expansion which you have personally observed.

The Application of Facts to Proofs.—(25) Prove that water is formed by the combustion of a kerosene lamp. (26) Prove that hydrogen sulphide contains sulphur.

The Interpretation of Phenomena.—(27) A piece of white paper on being held for an instant in the flame of a candle and at right angles to it, a black ring is formed on the paper. Explain what the ring indicates, and how the particles of carbon are formed, and why they are deposited on the paper. (28) A Roman candle on being ignited and then thrust under water continues to burn. How can this be accounted for? (29) Why cannot fish live in lakes on the tops of very high mountains?*

The Application of Knowledge.—(30) The iodine falls into the sand box. How can the iodine and sand be separated? (31) A mixture consists of barium carbonate, sodium sulphate, and sulphur. How can they be separated? (32) A manufacturer has a waste product consisting of a liquid containing 40 per cent. of sulphuric acid, 10 per cent. sodium sulphate, and 5 per cent. ferric sulphate. How can he treat it so as to convert it into other products that have commercial value?

Deceptive or Misleading Questions.—(33) Dilute sulphuric acid is poured upon zinc. A gas with a slight bluish† color is evolved, which burns with a red† flame. What is it? (34) Chlorine gas is collected in a jar over mercury‡ in the usual manner. It is then brought into a eudiometer, mixed with twice§ its volume of hydrogen, and exploded. How many volumes of hydrochloric acid gas will be produced?

The Imagination.—(35) Filthy water of the gutter, warmed by the sun's rays, escapes from a foul environment, and, condensing, sparkles like diamonds on the petal of the violet. Use this as basis for an allegory in life.

These questions do not by any means represent all the possible divisions of mental action, and I have purposely avoided those of a very technical nature, most of which, however, would fall under the heads given; but they will serve to indicate what opportunities there are to construct examination papers that shall test a student's knowledge and the working of his mind. It may be urged against the questions I have given that several of them might fall as well under one head as another, or that a few more elaborate questions could be made out and each question marked under the several heads. My experience, however, has not been that the real ends are best attained in this way. The question that is distinguished by its definite nature and object gets a clearer answer and gives a more satisfactory insight into the student's mental equipment and action than a long or complicated one. If, after teaching a student a subject for a certain time, an examination shows that he can bring forth nothing more than that which has been put into him, it may be inferred either that the teacher is incompetent, or that the student is intellectually deficient; assuming, of course, that the system in the particular institution permits the teacher to do his best, does not assign him more pupils than one man can teach, and requires the student to do the work assigned to him. In such case I think that the fault usually lies with the teacher. Still I admit that there are institutions in which educational work of a high pedagogical order is impossible, and mind development, as distinguished from mind cramming, is out of the question. In such a case students are produced who are saturated with knowledge, but who are incapable of utilizing it. Like water-logged vessels they roll about aimlessly, and are unable even to keep out of the way of craft which are taking the fullest advantage of wind and tide. In such an institution the earnest teacher, when he fails, deserves sympathy more than blame.

The results of examinations, conducted on some plan like the one I have attempted to describe, are very interesting. Such examination papers are far more difficult to write than the calls for mere memorization that are so frequently made on the student, and which a hasty cram will enable a fairly bright candidate to pass. The answers are more difficult to rate; and often an attempt to mark them according to the usual rules is unsatisfactory. It is quite easy to assign a mark to the amount that a student knows, or even to discriminate as to the quality of his knowledge. To assign a figure to his ability to apply this knowledge, to originate, to create, to act under its instigation, is more difficult; yet it can be done with a fair degree of success.

It must always be borne in mind that a man's value in this life does not depend merely on what he knows, but upon what he can do. Cæteris paribus, the more he knows, the more he should be able to do; for so much the greater should be the incentive, if the knowledge imparted to him acts on him as it should. Until technical education was introduced, this fact was not well understood, and it is still far from appreciated in many schools.

For instance: A shows in his paper an encyclopedic knowledge. In his answer to Q. 11 he recites with great precision the properties of silica and iodine. But he fails to answer Q. 30, which calls for a conclusion dependent upon this knowledge. He is like a recruit who has been given a gun, but has not been taught how to fire it off. Such a student demands the teacher's attention at once. His mental inaction is usually the result of poor teaching.

It may not be amiss for me to say parenthetically here that teaching is the most difficult of all professions. It is not usually regarded so, but I believe that it is. Much of what is called teaching is nothing more than a kind of pumping. Knowledge is forced in through the most convenient intellectual orifice, a great deal being lost in transitu, and not a little leaking out afterward. The engorged recipient is like a boiler whose feed pump is too big for it and will not cease pumping, but fills the boiler entirely full of water and leaves no space for steam; whereon the engine slows down and stops, or throbs soggily with its cylinder filled with lukewarm water instead of hot expansive steam.

Again, a student may fail in his attempts to state anything correctly or exactly; but he fills pages with attempts to apply his knowledge, suggesting all sorts of ideas and applications. Most of them may be impossible, some even ridiculous. But no matter, let the teacher take hold of this boy at once, for the mind of an Edison, a Siemens, or an Ericsson may be seeking nourishment and development. Happy is the teacher who can discern what mean the instinctive strugglings of the embryonic master mind, and who can liberate it from the thraldom of routine—who can guide its first weak attempts to walk and climb, until it becomes hardy and venturesome, and fearlessly scales cliffs heretofore inaccessible; and so clambering by hitherto unknown ways to the peak, discovers new fields for human activity, and cuts a wide path by which thousands may enter and take possession.

What man gets closer to the Creator than the teacher, who can discern and understand His idea as shown in the youth, and who clears away the obstacles in the way of its development, nourishes it until it is strong and independent, and itself becomes creative? Verily such a teacher has his reward.

Examination papers constructed on the basis I have suggested, viz., to test not only the knowledge possessed by the student, but also the working of his mind upon the particular subject, will show more clearly the nature and condition of a mind than the daily recitation, because the case is more capable of systematic study, and can be made to cover larger fields of mental activity. While I do not intend to suggest that such examinations should replace the regular recitation, I believe that they should be held frequently, and should serve a far wider purpose than that of merely noting the quantity of knowledge absorbed by the mind. Such an examination is not a mere matter of testing and registering; it is a creative exercise of the mind.—Science.

* Given in lectures and not in text book.

† Given in text book and demonstrated in lecture.

* Compare London University Matriculation Examinations, Stoker and Hooper, p. 31. Q. 6.

† Colorless.

‡ Chlorine cannot be collected over mercury.

§ Once.

OAK FORESTS OF THE SOUTHEAST ATLANTIC STATES.

THE following is by William Willard Ashe, in charge of the forest investigation of North Carolina geological survey.

A recent examination of the oak forests of the southeast Atlantic and adjoining Gulf States has convinced me that their condition is far different from what the general opinion holds, and is worthy of careful consideration. The territory referred to embraces the States of Virginia, North and South Carolina, Georgia, Alabama and eastern Tennessee, in all about 250,000 square miles.

In eastern Virginia there is no merchantable milling oak and the woodland of second growth pine is increasing in extent yearly. The eastern part of North and South Carolina, Georgia, southern Georgia and southern Alabama offer no milling white or red oak, the West India stave trade and later the turpentine industry having used these timbers, and in places have removed even the inferior white oaks, the burr and swamp chestnut oaks. The oak timbers remaining are the porous water oaks which show on quartering scarcely any silver grain; and this timber is confined to the narrow bands of hardwoods along the streams and swamps which alternate with the broad stretches of pine forests, and only along the coastal plain region of South Carolina form belts of unbroken continuity for considerable distances. The uplands along this coastal region, bordering both the Atlantic and the Gulf, after the removal of the pine, have a regrowth of small oaks, barely yielding tie timber, or of pine again. Florida, which has no oak of commercial importance, except in the northwestern part of the State, can be included in this region.

The oak lands of the middle parts of these States, with a growth chiefly of the black oak, white oak and southern red oak (Spanish oak), for the most part form a portion of the woodland on small farms, and their timber cannot be classed as merchantable timber on account of the general desire among the owners to retain it for farm use, since in many instances it is barely enough for present home requirements. Some of the furniture factories, through here, although most of them are small, find it difficult to obtain timber suitable for their requirements near at hand. The pine lands of these middle districts, on the other hand, having a poorer soil, have much small oak, mixed with the pine, chiefly post and small white and southern red oaks suitable only for posts and ties. This condition of the oak lands probably continues uninterrupted throughout western Tennessee and northern Mississippi until the fertile bottoms of the lower Mississippi and tributary rivers in Louisiana, Mississippi, Arkansas and Indian Territory are reached, with their still compact forests containing Texas red oak, burr and cow oaks.

The forests of northern Georgia, except in some of the counties abutting the Blue Ridge, have been well culled, and the same can be said of the once great hardwood forests of northern Alabama, lying in the valley of the Tennessee River and extending to the northward through middle Tennessee; while the forests of central and northeastern Alabama, on the pla-

teau between the Coosa and Tuscaloosa rivers, have been stripped to satisfy the needs of the iron industries and their accompanying progress and development.

In many of the counties of eastern Tennessee, southwestern Virginia and western North Carolina, the timber lands are small farm holdings, whose yield is not more than sufficient for local use, while the great bodies of compact hardwoods cover only a comparatively limited area.

Even in several of these States, which are noted for their production of pine, the removal of the heart pine in many sections has brought the oak to the front as its best substitute for many purposes, and post oaks, young white and even southern red oaks are being used for ties and posts in places where ten years ago only pine was used. The extent of these demands for oak is daily increasing. Not only are the local uses increasing, but within the past few years there has arisen a strong demand for this oak from northeastern markets, as is well shown by the fact during the past year, 1894-95, 300,000 oak ties were shipped from North Carolina for use on Pennsylvania railroads. Moreover, the oak forests, except in the upper parts of these States, show little reproductive power. The black oak, next to the white oak the most widely distributed and, as a milling timber for general building uses, the most valuable oak of this region, is extensively dying, and the southern red oak also, though to a less extent than the black oak. Neither of these trees shows abundant young growth like the post oak, which, with other trees of less value, is in many places succeeding them. The present situation is anything but encouraging and the outlook certainly not favorable.

ANTELOPE IN THE BERLIN ZOOLOGICAL GARDEN.

ANTELOPE IN THE BERLIN ZOOLOGICAL GARDEN.

WE publish herewith an engraving (for which we are indebted to the Illustrirte Zeitung) of a graceful little antelope—Tragelaphus silvaticus—that is one of the latest acquisitions of the Berlin Zoological Garden. This little antelope is about 3 ft. 3 in. tall and its horns are from 11 in. to 15 in. long. Its coat is of a dark chestnut brown, with white marks, which are well shown in the picture. The long hair on the tail and hind legs is brownish red, and through the thin hair on the neck—a characteristic mark of this species—the mouse colored skin shows. Quite a variety in the coloring has been noticed. Only the males of this species have horns, which are slightly twisted and make an excellent weapon for defense from dogs and other enemies. The home of these pretty antelopes is generally supposed to be in the southeastern part of Africa, but they are also found in the western part of that continent. They live singly or in pairs in the thick woods along the rivers and go forth at night to feed, often breaking into the plantations and gardens, where they carefully avoid the traps that are set for them. They are hunted more on account of the damage they do than because they are prized as game.

ROBBER BIRDS OF CENTRAL PARK.

JUST before sunrise one morning last week the tame ducks swimming in the lake, near Eighth Avenue, about opposite Sixty-fourth Street, in Central Park, suddenly began to quack and scatter in all directions toward the shores and bushes. The geese showed signs of excitement and the swans twisted their long necks that they might look overhead. A gray squirrel in an oak on the west side of the lake crouched against a branch, while several birds screamed in discordant voices.

The cause of this panic was a red-tailed hawk, a bird common enough in the fields in New Jersey and on Long Island, and seen now and then by men employed in the park. The hawk was sailing over in true country style. He circled without a wing movement, or hung with flapping wings as if about to dive at some bird. Then again he would fly as if going on an important business errand. That a bird so wild and so given to the fields should be searching for food in the center of a big city struck an observer as remarkably curious. So he went around and talked with several policemen and keeper No. 2. He found that hawks of four varieties, owls of four varieties and one kind of eagle had been seen in the neighborhood by park observers.

The bald eagle is the one kind of eagle seen. One remained more than two months in the park several years ago, and since then bald eagles have been seen there occasionally for a night or so or have been seen sailing over the park and city on their way to the highlands of the Hudson, where they are said to nest. The nests are built in tall trees, and are a jagged mass of sticks. The birds live principally on fish, and this accounts for their coming to the park. In the reservoir are perch and rock bass, some weighing as much as three pounds each, according to the story of a watcher. Smaller fish abound, as anybody knows who ever threw a few crumbs of bread into the lakes.

But eagles are not so common in the park as fishhawks. The fishhawk is a big bird, measuring as much as 66 inches across his outspread wings. As his name implies, he feeds exclusively on fish, usually taken alive. The fish are captured by the birds descending with closed wings from a height of 50 to 150 feet, and frequently going well under the water. This is the bird that is said to strike fish too large to be lifted from the water, and, being unable to release his hold on the fish's back, often is drowned. Fish have been caught with the claws embedded in their backs, only the legs of the bird being left, as the rest has been devoured by other fish. The fishhawks are more likely to be seen over North River, from Riverside Park, but they have been seen several times at work in Central Park lakes, and it is said to be the presence of the fishhawks there that attracts an occasional eagle ready to rob the fishhawks of their prey.

The sharp-shinned hawk is a dashing fellow. He goes through the woods and strikes his prey as it is scared from its perch. In Central Park he gets plenty of game. Gray squirrels, sparrows, pigeons and a host of other kinds, large and small, are his food. The pigeons come into the park and are fed by the drivers at their rendezvous just above the reservoir, where several always can be found.

The sharp-shinned hawk knows about this resort, and comes whooping through the woods, his progress announced by terrified cries of small birds. Swiftly striking one of the pigeons, he carries it away in a wink. This hawk is the true hen falcon. It is well known that he will come into a farmer's dooryard, pick out a savory spring chicken and lug it off before the farmer's jaw has had time to drop, but not so many know that he is a frequenter of the park. This hawk is not a talker. He does not scream and let everybody know he is coming—the little birds do that for him. But in the love making season he coos to his sweetheart in a most tender fashion.

The American sparrow hawk may be seen sometimes perched on the topmost branch of some tall tree in a field of Central Park, waiting for a victim—a bird, or a mouse, snake or insects. When game comes below him down he goes, and clutches his prey, and then flies up to his old stand and there feeds leisurely. The sparrow hawk is often a victim of the sharp-shinned hawk. The sharp-shinned hawk makes his capture of a sparrow hawk in the same dashing fashion that marks his descent on a robin. He strikes in midair and drops with his victim to the ground to kill him. But this is not often seen by men.

There is a mounted group in an Adirondack home in which a sharp-shinned hawk has a sparrow hawk clasped in his claws. The two were killed in that position at one shot by a boy. This is one of very few such groups known, although it would be easy to kill a sparrow hawk and a sharp-shinned hawk separately and have them mounted.

Hawks fly in the day time, when the city noises are loudest, and so probably do not come so frequenty as they otherwise might, but the owls are night birds. They are seen often by park policemen, who have killed several of them.

One night, two years ago last spring, a policeman was walking in the ramble when he saw three, an old one and two young ones. The policeman, who wouldn't give his name, thought about his boys at home, and wondered if he could not get one of the young owls for a pet; so he caught one of the owls, but the old owl went for him, knocked his hat off, tore his coat, and scratched his hand. When the policeman released the captive the old owl fluttered in his face, and made jabs at his chin and neck until the young one had got into a tree several rods away. The policeman did not try to get any more young owls after that, although he had several chances, for he had seen two or three of their nests very early in the spring. The owls were barred owls, probably.

Very often in the park at night the hooting of owls

is heard. As the birds are numerous, it is easy to get within hearing distance of one, but it is harder to see them.

The saw-whet owl is seen in the park occasionally. He is about the size of the woodcock, and so resembles that bird in flight that the eminent naturalist, Fisher, once killed one of them, thinking it to be the game bird. His dog pointed the owl after the fall, and not until the naturalist got a close view did he recognize the bird as an owl. The owl's voice sounds like the filing of a large toothed saw. His principal food is mice, although he has been known to eat both birds and insects. Anybody wishing to see the little fellow should go at night to the woods at the north end of the park.

Even the rare snowy owls have been seen in Central Park. The snowy owl is unmistakable. He is the handsomest of his kind. Only a few dark, grayish brown bars mark his white feathers. His eyes are big and yellow, his legs well feathered. Being about two feet in length, he is a conspicuous as well as imposing bird. The snowy owl breeds in Labrador and northward, but wanders southward in winter as far as Texas. Big as he is, he depends chiefly on mice and small birds for food, but now and then he gets a game bird.

The policemen in the park often kill owls with their revolvers. One told the reporter he had killed three in two years, which is more than have been killed by all the woodsmen in the Adirondack town of Northwood in five years.—New York Sun.

THE KEA, THE SHEEP-EATING PARROT OF NEW ZEALAND.

THE kea, the mountain parrot of New Zealand (Nestor notabilis), has earned considerable notoriety from its remarkable habit of attacking living sheep. It is commonly stated that the natural food of this bird consists of insects, fruit and berries; and that it has developed a taste for a carnivorous diet only during the last thirty years. Mr. Taylor White, however, has recently pointed out (Zoologist, August, 1895) that the various statements on the habits of this bird have all been derived from second-hand information; and, as the habitat of the parrot is on the tops of Alpine ranges, owners of sheep and shepherds who in winter and summer search the mountain tops for their stock are the men best fitted to tell us about the habits of the bird. On observations made during such experiences Mr. White bases his own account. In the district with which this writer was acquainted, the kea always lived high up on the mountains, among rocks and bowlders, a long distance above the forest line; in such a situation, of course, berries and fruits were out of the question, and the bird appeared to live on lichen and any insects it could find. Even when the ground was covered with several feet of snow, and when roots and other food were out of reach, lichen growing on steep rocks would still be obtainable by the bird. The view that the diet of the kea generally consists of fruit and berries would thus appear to be erroneous.

It will be remembered that Wallace and others state that the kea regards the kidneys of sheep as a "special delicacy," and that it attempts to burrow into its victim in such a way as to reach this part. Mr. White, however, opposes this prevalent view, and regards it as probable that the bird desires to obtain the blood of the sheep rather than the kidneys; and in support of this view states that he has never seen a dead sheep attacked by keas. The fact that the kea so frequently pierces the body of a sheep in the region of the kidneys is due to the position it takes on the back of its victim to maintain a firm hold—a position from which it cannot be easily dislodged, as it could from the head or rump of the sheep. In corroboration of this, Mr. White mentions that sheep with long wool are more frequently attacked than animals with short wool; as apparently the long wool gives the bird better facilities for holding on with his feet when drilling a hole into the back of the sheep. It is not very easy to conjecture how this habit of attacking sheep was first acquired by the kea. In winter time the sheep are covered with snow, and often have icicles hanging to their wool; and it is suggested by Mr. White that keas may have mistaken sheep so disguised for snow-covered patches of rock. It may further have happened that when searching the supposed rocks for insects, the birds in some cases would taste the blood of the sheep. "When some of the birds had once found out that the blood of the sheep was good for food, others were soon initiated into the performance." It is possible that in some such manner the kea may have gradually acquired this curious and unattractive habit which renders the bird such a pest to the New Zealand farmer.—W. Garstang, in Nature.

THE KEA, THE SHEEP-EATING PARROT OF NEW ZEALAND.

LUMINOUS ANIMALS.

By THOMAS R. R. STEBBING.

IT is sometimes said more than half in earnest that all man's ingenious inventions have been anticipated by the lower animals, or in natural processes with which the human mind has had no concern. In the construction of dwellings, in the storage of provisions, in tunneling under the ground, in damming the course of rivers, in the arts of spinning, weaving and netmaking there can be little doubt that birds and bees and ants, that moles and beavers, that spiders and caterpillars were at work long before mankind engaged in architecture, engineering or other artistic operations. Jelly fish and sea anemones carry innumerable darts, the action of which has been pertinently described as lasso throwing.

The stings and lancets of insects, the sharp-edged grasses, the gigantic thorns, the seeds which bury themselves in the flesh of sheep, are comparable with many of man's later devised weapons of offense. Long before any human sculptor wrought in clay and marble, thousands of shells and fishes, the carapaces of crabs and tortoises and armadillos, and the skeletons of marvelous beasts had been made monumental by nature's manipulation. In the curious fossils called graptolites, it might almost be said that the same teacher has given a lesson in the art of drawing.

Prior to all hour glasses and clocks, the shadow cast by the sun, the positions of the moon and stars, the regular recurrence of the tides, the opening of various flowers, provided a natural registration of time. In accordance with these examples it may be added that, if man has learned how to light up his dwelling-places and to expel the darkness of night from his towns and villages, nature has produced a similar result, not only on the surface of the globe, but also, where it was least expected, in the abysses of the trackless ocean.

Art, indeed, must always work by natural means, so that, whatever human ingenuity contrives, it will always be possible to show that nature has been beforehand in the field. As far as can be made out, man himself is a quite recent invention. There was opportunity, therefore, for many things to come to pass before he appeared on the scene. Of all the products of nature, late or early, with which he can be compared, he seems to be the noblest. But his most conspicuous endowment consists in the capacity for turning to his own advantage endowments external to himself. The antithesis between art and nature, at times absurdly used for the sake of disparaging mankind, is only then of profit when employed to quicken, to guide, to encourage the efforts of human thought. In those natural objects which are the subject of the present paper, beyond the characters and qualities which appeal to sentiment or which interest the student, may lie yet undiscovered treasures of suggestion for the inventor and of practical benefit for human life.

In utilizing the powers and imitating the machinery of nature, art must certainly somewhere have its limits; but the impossible has so repeatedly been accomplished that no one can exactly say what or where those limits are. Where the scale of working deals with vast dimensions, competition may be arrested by its being found to be unprofitable before it is found to be futile. At the opposite extreme it may have a vision of advantage, and still not much prospect of success. For, if one may say so, nature excels in making things small. Though the skill of man can produce a working steam engine which will fit into a walnut shell, such toys are unwieldy compared with the microscopic animals of which our globe possesses a vast abundance both in number of species and number of individuals. It is among the commonplaces of wonderment that within a scarcely perceptible mass of matter there should be contained, not merely the mysterious principle of life, but also, with exquisite neatness packed and dovetailed together, organs of volition and sense, of motion, nutrition and reproduction. As if this complicated machinery were not enough for the space employed, there is frequently added a lamp, either automatic or such as the animal can light up and extinguish at its will. Of the organisms, larger or smaller, possessing this last remarkable provision, there is a variety probably far greater than most persons suspect.

When even a poet can bring himself to speak of "sun dazzle," when the views of an opponent are fairly described as "all moonshine," it is evident that the grandest sources of terrestrial light have not escaped the usual penalty of being "so common hackney'd in the eyes of men." With seashine or the phosphorescence of the sea, few or none are so overfamiliar as to treat it with friendly contempt. Of its causes most people know nothing, not many know much, and those who know most are still anxious to know more. Its highest brilliance has, for the generality of observers, the happy quality of being rare, without which the most magnificent shows soon lose their impressiveness to human eyesight.

The phenomenon, however, is not especially local or especially unfrequent in occurrence. Yet, owing simply to want of opportunity, millions of men must pass through life without a single chance of observing it at all. In the history of seamanship, both early and late, the displays of it have courted marked attention. The earlier records are full of surprise; the latest cannot refrain from admiration. It is not uninteresting to notice how commonly, since the invention of printing, the intensity of the light has been appraised by its enabling the voyager to read. Thus in 1605, in the narrative of "The Second Voyage of John Davis, with Sir Edward Michelbourn," it is stated that on "February 12, we were in 7 degrees 5 minutes south latitude, and here we had the surprising sight of a sea sparkling at a wonderful rate and appearing as if all on fire; the light was so clear and bright at night, that one might have read the smallest print by the assistance of it." So, too, writes Capt. John Saris, on the occasion of his crossing the Arabian Sea in 1612, from Zocotora (Socotra) to Cape Comorin:

"After we had parted from the island we were one night surpris'd with a strange sparkling and glaring of the water all about us. 'Twas but just before so dark that one could not see half the length of the ship any way round, and now there was such a clear skie on every side, as would have serv'd to have read by tolerably well. And this was not a sudden flash of light that gave a short glare, and then was gone again presently, but it held us for a matter of half an hour sailing; and when all came to all, and the philosophy of the whole fleet was puzzl'd to find out the cause of it, 'twas a parcel of cuttle fish swimming about us that made this appearance, and were so kind as to afford us the assistance of their light in the dark night, when the stars denied us theirs."

Some two hundred and fifty years later Sir Wyville Thomson, an accomplished naturalist, describes as follows his experience of this phenomenon when traversing the Guinea current in the Atlantic:

"From the time we entered the current, immediately after leaving the Cape Verde Islands, the sea had been every night a perfect blaze of phosphorescence. The weather was very fine, with a light breeze from the southwestward. There was no moon, and though the night was perfectly clear, and the stars shone brightly, the luster of the heavens was fairly eclipsed by that of the sea. The unbroken part of the surface appeared pitch black, but wherever there was the least ripple the whole line broke into a brilliant crest of clear white light. Near the ship the black interspaces predominated, but as the distance increased the glittering ridges looked closer, until toward the horizon, as far as the eye could reach, they seemed to run together and to melt into one continuous sea of light. The wake of the ship was an avenue of intense brightness. It was easy to read the smallest print sitting in my cabin; and the bows shed on either side rapidly widening wedges of radiance, so vivid as to throw the sails and rigging into distinct lights and shadows."

In this case the philosophy of the ship was not puzzled to find out the cause; but when all came to all, found the brightness chiefly due to shoals of a large Pyrosoma, which glowed in the water with a white light like that from molten iron. That the radiance observed by Captain Saris was principally due to cuttle fish is open to some question. Darwin, indeed, when on board the Beagle, observed that a cuttle fish which he kept in his cabin was slightly phosphorescent in the dark. Mr. W. E. Hoyle and others have also shown that some species of cephalopods are very beautifully luminous. But it does not follow that they are capable of lighting up a considerable tract of ocean. They are ravenous animals, and when caught by Saris and his companions, they may have been traveling among and preying upon swarms of creatures collectively far more effulgent than themselves. All the great divisions of the animal kingdom contain luminous species, but some of the divisions have a far larger share than others in lighting up the ocean. Often a soft diffused light is spread over vast stretches of its waters by minute organisms of the simplest type. Some of them seem to belong almost indifferently to the realms of zoology and botany. A representative of the animal species of this class has a name that signifies "a grain which illumines the night," while a very similar vegetable species is called "the night gleaming capsule of fire." They redeem their insignificance of size by being present in incalculable myriads. Probably none of the higher animals surpass them in the total effect of their radiance.

In ancient times the term mollusca was vaguely applied to a heterogeneous multitude of beings which have little in common except the softness of their bodies and the absence of a vertebrate skeleton. Within stricter modern limits, the molluscan group, with its shell fish and snails and cuttles and slugs, both of land and sea, is still very extensive. But among the purveyors of light it holds a rather subordinate position. Nevertheless, it is a true mollusk that makes the earliest mark in the history of animal phosphorescence. Pliny was not only aware of

this phenomenon in the shells which he calls dactyli, and which are still called Pholas dactylus, but pointedly contrasts it with the unverified tale of a fiery star-fish, because it was a marvel which could any day be put to the test. They glow, he says, in the dark, they gleam in the mouths of those that eat them, they gleam in their hands, and when drops fall from them, these, too, glitter on the ground or on a person's clothes.

Many things are eaten in Italy, it must be remembered, which we in Great Britain are too fastidious or too ignorant to enjoy. The Pholas, moreover, appears to be somewhat capricious as to the emission of light in cold countries, so that Pliny's pleasing picture of a reveler gilding lips and lap with the dainty juice cannot every day be realized among us. It seems to have been generally supposed that the Pholas was luminous all over. But Pliny's countryman, Panceri, professor of comparative anatomy at Naples, discovered about twenty years ago that there are special organs from which the luminous material issues. Opening the mantle and anterior siphon, he cleared away the overflow of mucus by pouring a thin stream of water on to the animal, and in the darkness the definite position of the luminous organs could then be seen. Moreover, when these parts were cut away luminosity entirely ceased. Our own eminent conchologist, the late Mr. Gwyn Jeffreys, was evidently wrong in supposing that the Pholas owed its light to extraneous microscopic organisms. It may be thought strange that the Pholas should need a lamp, for it makes its burrow with so narrow an opening that the valves of its shell are forever imprisoned, nor can its soft body be detached from the cloistered valves. It can, however, elongate its body to an extraordinary extent, and thus explore quite as much of the universe as it requires to know. Have we not read of the crafty entomologist lurking beside his lantern while moth after moth is lured to the treacherous gleam? Even so it is to be surmised that, when the Pholas sheds its luster through the surrounding water, it is not so much absorbed by the beauties of nature as intent on absorbing them.

At the mention of Phyllirhoë the romantic reader may begin to hope for some story of a sea nymph who loses her heart to a beautiful prince of mortal clay, with all the intricate and tear moving results that are likely to follow such an entanglement. The disappointment must be borne of learning that Phyllirhoë, like Pholas, is only the name of a mollusk. It is a mollusk without a shell. It is not immured in a burrow, but swims freely on the bosom of the ocean. It is not given to ejecting clouds of slime. It is so purely transparent as to be almost indistinguishable in the water by daylight. An animal made as it were of living glass, in which the inner structure to the last cell can be examined without the trouble of dissection, is convenient to the student of anatomy. Nor was Phyllirhoë by any means neglected. So much the more surprising will it seem that it was left to Panceri to discover its luminous power. But this surprise itself will vanish when we reflect that for examining a transparency a man does not choose to shut himself up in the dark. As it is only in the dark that the effulgence of the Phyllirhoë can be seen, its discovery came more by choice than chance to one whose mental vision taught his bodily eyes to search for this form of enlightenment.

The class of the Cœlenterata is far below the Mollusca in the scale of existence, but it probably contributes much more largely to marine illumination. The name of this great class refers to the important, but not altogether unusual, incident that within their bodies there is a hollow, and that this hollow discharges the valuable function of a digestive cavity. Many of the group are known under the more poetical, though very inaccurate, title of Zoophytes or animal plants. In addition to the medusæ or jelly fishes, the class contains the sea anemones and corals, the gorgonias, often widely branching, and the sea pens, the hydroids frequently confounded with sea weeds, and many rarer forms, such as the strangely beautiful "Portuguese man-of-war," and the gracefully undulating "Venus' girdle." Not always do the inexperienced readily accept the statement that the supposed sea weed or so-called coralline is in reality a colony of numerous animals intimately united like the leaves and flowers on a tree. But when the living hydroid stem is placed in a vessel of sea water, and from every point a polyp pushes forth its delicate crown of tentacles, incredulity gives place to charmed surprise.

From such colonies there issue at times free swimming bells, which are fitted to produce eventually fresh colonies. These little medusæ, like their larger kindred, under any agitation, can be seen to sparkle in the darkness, and any one staying at the seaside can make abundant opportunities of witnessing this pretty phenomenon within doors. Among the Ctenophores or "comb-bearers" the little Beroë is tolerably familiar. This and its immediate kindred are compared by Gosse to tiny melons of glass, striped with bands or meridian lines of paddles, which, by the regular motion of the cilia composing them, row the little crystal globes along, with an even, graceful, gliding motion. At night time they flash fitfully about, "frisking light in frolic measures," while the great jelly fishes move on in more solemn gliding state, by slow contraction and expansion of their pale gleaming spheres. By a curious ocular delusion it was at one time supposed that the luminous matter circulated in the rib-like bands of the Beroë, but Macartney at the beginning of this century showed that the appearance of a streaming fluid was really due to the extremely rapid movements of the ciliary paddles. Among rare though widely distributed forms are the species of Umbellula. Deep down in the water these peculiar zoophytes rear their slender stems surmounted by a group of polyps, superficially resembling the lily-encrinites of a bygone age. In the middle of the eighteenth century a fine species was observed and described, but the specimens were lost, and then for a hundred years no more was heard or seen of the genus, till it was again brought to light by the Swedish frigates Ingegerd and Gladan. Soon afterward the Challenger raised the number of known species to half a score. One of these was fished up from a depth of more than 2,000 fathoms between Cape St. Vincent and Madeira, and "when taken from the trawl the polyps and the membrane covering the hard axis of the stem were so brightly phosphorescent that Captain Maclear found it easy to determine the character of the light by the spectroscope." It will perhaps be encouraging to those naturalists who are too easily disheartened by failures and mistakes to learn that the celebrated Father Zecchi in the first instance decisively affirmed that the phosphorescent light of animals, viewed by the spectroscope, was monochromatic, whereas in 1872 he was able to determine just the contrary. He then found, by means of improved instruments, that the spectrum was sensibly continuous, not one-colored, but compound, with the red and the violet clearly distinguishable.

Zoophytes not very remote from Umbellula are the sea pens, represented in British waters by some beautiful forms, among which the crimson Pennatula phosphorea indicates by its specific name its luminous character. The general gracefulness exhibited in this group may be in part inferred from the fact that the terms rachis and pinnules are borrowed from the fernery to describe them. To whatever point of the rachis or pinnules a stimulus is applied, thence will the signal be passed on, each polyp in succession lighting up its little lamp till the whole colony is illuminated. Of another polyp-bearing family found off St. Vincent at a depth of 600 fathoms, an alluring description has been given by Sir Wyville Thomson:

"The trawl," he says, "seemed to have gone over a regular field of a delicate simple Gorgonoid, with a thin wire-like axis, twisted spirally, a small tuft of irregular rootlets at the base, and long exsert polyps. The stems, which were from 18 inches to 2 feet in length, were coiled in great hanks round the trawl beam and entangled in masses in the net, and as they showed a most vivid phosphorescence of a pale lilac color, their immense number suggests a wonderful state of things beneath—animated corn fields waving gently in the slow tidal current and glowing with a soft diffused light, scintillating and sparkling on the slightest touch, and now and again breaking into long avenues of vivid light, indicating the path of fishes or other denizens of their enchanted region."

Among the star fishes there are luminous Ophiurids, one or other of which perhaps gave occasion to the story of the fiery sea star recorded but discredited by Pliny. Of marine worms, many of which are beautifully iridescent in daylight, several are luminous in the dark. There is in our country a luminous earth worm.

Ascending a step higher in the scale of organisms to the Arthropoda, or animals with jointed legs, we find among the Crustacea and insects a great wealth of radiant animals. When the Italian vessel Vettor Pisani was going round the world, on May 5, 1885, in the Indian Ocean, she met a regular drove of Ostracoda, which it took her four days to traverse, over a stretch of 420 nautical miles. The Ostracoda are small crustaceans shut up in shell valves, so that they resemble mussels rather than crabs or shrimps. On the occasion in question it is calculated that each liter of water—that is, nearly a quart—contained perhaps not more than a hundred of the tiny specimens, but nevertheless the light that issued from them on the sea, sometimes in long streaks, sometimes in patches of circular form, was most brilliant. Professor Della Valle quotes with well deserved praise the following account given of them by the sailor naturalist Chierchia:

"When these animals were placed in a tumbler, whether shaken or not, they gave forth from the caudal part a phosphoric fluid which dispersed itself in the water, while their bodies remained continuously shining. When one of these little crustaceans stood still, the emission of the fluid proceeded just after the fashion of cuttle fishes when they throw out their ink and remain concealed in it; if, on the other hand, the animal moved, which it always did by describing a long curve, the brilliant point of the body furnished by the phosphoric tail made it like a comet in a miniature sky.

"After the first expulsion of fluid, the animal appeared to concentrate its forces in preparing another supply, and its presence could always be detected by means of a very brilliant point of small dimensions. The quantity of luminous matter emitted by each individual, relatively to its volume and the time, was enormous, so that in a short period the water became phosphorescent enough to make writing legible by it in the darkness of the night. By rubbing the animal with a finger upon any substance, the same effect was produced as by rubbing the head of a lucifer match.

"Many of these Ostracoda in a tumbler of water, observed from time to time through a whole night, continued to shed out light, though with diminished intensity; and those which remained alive, when carried into the dark after sunrise, resumed their luminous function. Others put into a box with strong alcohol, though ceasing to give out fluid, remained sufficiently luminous to constitute a pretty lantern showing a green light; the luster thus obtained lasted about fifteen minutes, gradually decreasing as the alcohol, penetrating to the interior of the animals, resolved or dissolved the phosphoric substance into its elements. On the other hand, when put into a solution of corrosive sublimate they suddenly lost life and light; and if the solution was rather strong, this liquid also assumed a phosphorescence which rapidly vanished."

(To be continued.)

EARLY LIFE FORMS.

AT a recent meeting of the Boston Scientific Society, the paper presented was entitled, Early Life Forms and Functions, the speaker being Dr. John S. Flagg. "Prof. Dolbear, in his address here last year," said he, "discussed the elements of motion; the present paper will be a consideration of the elements of biology." It will therefore lie within the limits of embryology, which comprises a history of the organisms of plants and animals from their very beginnings as individuals. The study of plants is very useful, since there are marvelous relationships between them and animals, it being true, for example, that the ovum of the lily is almost identical in its nature with that of the human species.

Life and its origin is a very old topic, as indeed are some of the explanations of the phenomena. We know that the old philosophers were keen observers, we find that they noted the ways of animals, they saw how closely they resembled each other, and throughout their writings we find evolutionary statements. Evolution is an idea as old as human writing; it is to be found in the sentences written on the leaves of the papyrus, and in all subsequent works of philosophers. Of course their ideas are not the developed ones of the present century, but rather the fundamental one of relationship and development.

The scientific men of to-day are agreed that the theory of evolution is the only one that accounts for the development of species. There are two ways in which different authorities have tried to explain how complex organisms could have been derived from simple ones. The first is the theory advanced by Lamarck, a naturalist of a century ago, and the other is that of Darwin. Lamarck thought that environment affected the functions of the organism, and that the change of functions affected the form. Darwin's supposition is that every individual passes through the leading forms of lower animals either at the same time or at an earlier stage of its existence.

Now the basis of science is facts, and upon the collection of facts depends every scientific statement. In the development of animals, two kinds of facts must be collected—those bearing on its anatomy and those relating to its physiology—and any peculiarities in either of these departments of research must be accounted for in the embryo. No animal or organism can be studied throughout its ontogeny, which is the life history of an individual, a or b. And likewise no species has as yet been studied thus thoroughly from beginning to end, but by the consideration of parallel species or individuals gaps may be closed and a perfected story secured.

Taking the facts which may be observed in the close examination of an organism, it becomes evident that it has passed through a number of different stages. There are some other organisms which have arrested their development at intermediate stages, some have developed less quickly to the same stage, and others still have carried on their development on a slightly different line. These are the facts which led Darwin to his theory, and it should be said that he supported his opinions with such a mass of facts when he presented them that the scientific world has really been obliged to accept them. The classes which have opposed his ideas Dr. Flagg does not consider to have urged scientific reasons, but rather philosophical ones, and included those who were committed to a special creation or to some special belief.

Coming down to the subject in hand, Dr. Flagg stated that no one knows what life really is—that is to say, the ultimate force upon which life depends. But we do know and recognize life by the phenomena which it presents. All life has five essentials by which it may be known: sensation, motion, nutrition, growth, and reproduction.

The very simplest form of life known is the Monera, or sea or lake slime. Several species have been determined principally by their motions. The Monera is a bit of protoplasm, which exhibits sensation by withdrawing from acid contacts; it absorbs food and grows larger, and breaks into pieces. But this can hardly be considered as a legitimate form of reproduction, to observe which it is necessary to go higher in the animal kingdom. It may be seen first in the amœba.

The amœba is a bit of protoplasm which has developed an outer envelope, probably through contact with outer influences, and has also a nucleus, which can be observed with refracted light. Its method of feeding is to flow itself about its food, passing the same by the most direct line to the nucleus. In this process, if the body is complex, it is "broken down" chemically and in this condition is passed out of the organism. The force which is liberated in the breaking-down process is that which gives the amœba its life.

As the organism increases in size, an elongation is noticeable in the nucleus, and finally the single amœba becomes two, each with a nucleus, and each one capable of increase in size in the regular way and of reproduction by the same method, which is termed fission. The general reason for this process is this, in the amœba it is the office of the envelope to secure food for the inner portion. The increase of the surface is of course as the square of the diameter, while the solid contents, which is to be sustained, increases as the cube of the same measure; hence there comes a time when the surface can no longer provide food for the whole organism. More surface is needed, and the amœba simply divides itself into two parts. The circumstances under which this occurs include the presence of plenty of food material, so that hunger is not an element in the matter.

Environment is the source of food supply which conduces to growth; but environment also presents varying conditions of light or heat to the organism, and there is also more or less expenditure of force, and indeed under some circumstances the outgo is greater than the income, and the cell perishes. For this and other reasons, therefore, communities of cells are formed, some external and exposed to the buffets of a cold world and others internal, about which the exterior cells cluster.

Thus we have a cluster of cells, the different members of which are exposed to different influences. If the light impulses are the stronger, the specialization of the cell becomes eye-like, and for sound, ear-like, and thus differentiation becomes more and more appreciable. All of these cells are growing through the offices of the outer group which supply nourishment to the inner ones, and these in the language of the speaker, "become fat and lazy." The outer cells, exposed to the outer influences, become more and more nervous, and the inner ones, protected as well as fed by the others, become even more sedentary and tranquil.

After a while the colony becomes too large, and, like other bodies in similar conditions, it breaks apart. The nervous cells, separated from the rest, find their outgo greater than their income, since they are susceptible on all sides to influences to which they respond, while before they are protected on some sides by contact with other cells. These therefore cannot live. The fat internal cells, although unused to contact with the world, are in an equally unfortunate position, and they also die; but when two cells join each other, one a nervous cell and the other an interior cell, the combination is one which can endure, and which can live to perpetuate itself.

"These two kinds of cells," said Dr. Flagg, "I have

traced down from these simple beginnings to the complex cells in the most highly organized being, the genus homo, and they are identical in character, the interior cells with the ovum, and the exterior ones with the spermatozoön." Here is the very earliest sex differentiation, the characteristics of which persist in the higher forms of organisms.

Carrying the development a step further, the speaker referred to another relation of the cells of Metazoön, the division to which all differentiated cells belong. It has been found that these cells formed themselves into colonies which were circular or spherical in form, the larger cells at the bottom and the smaller ones on top. Through some uncongenial environment the larger cells were induced to withdraw themselves to a contact with the smaller ones, forming a cup-shaped colony of two layers—the two-layered animal, as it is termed. In these two layers we find the beginnings of tissues, the one being traceable in the cells of the tissues of sensation, the other in the digestive and skin tissues. Every animal at some stage of its embryology is a two-layered one; and from the outside cells come the organization of motions and from the inside ones the digestive tract and digestive muscles.

The paper was enlivened with personal reminiscence, a mention of the experiences of the speaker as a student in Haeckel's laboratory, and many matters were considered in minute detail, illustrated with sketches and diagrams. "The whole matter," said the speaker, "so far as I have been able to outline it this evening, is but the doorstep to the great edifice of biology."—Boston Commonwealth.

BATHING IN ANCIENT ROME, AND ITS EFFECTS ON ROMAN CHARACTER.

By ARTHUR INKERSLEY, San Francisco, Cal.

THE Romans of early days indulged in bathing merely for the prosaic reasons of health and cleanliness; but in later and more luxurious times these ceased to be the only or even the chief motives for indulgence. The Thermae, or hot baths, under the empire were vast institutions, comprising almost every known appliance of luxury and recreation. The passion of the Romans of imperial times for bathing was indulged so excessively that it has been said to have been little less pernicious to their moral character than the exaggerated fondness for the bloody and brutalizing sports and contests of the amphitheater.

One of the many ways in which rich Romans, ambitious to gain high office, courted the favor of their fellow citizens was throwing the baths open for a day or two free of charge, by the payment of a good round sum to their proprietors. Agrippa carried this indirect and indiscriminate bribery to a very high pitch. He built no fewer than 170 smaller bathing places, and one huge establishment, decorated with paintings and sculpture of great costliness and merit, where bathing was combined with gymnastic and athletic sports, and enlivened by song and music.

Yet the baths of the wealthy Maecenas and of Agrippa, handsome and well equipped as they were, were surpassed by the structures which succeeded them. The halls in which the bathers strolled were elaborately adorned with columns of marble, and with elegantly designed mosaic pavements. On the walls were frescoes and paintings; the ears were charmed with instrumental and vocal music, and poets seized the chance of obtaining listeners for their latest works. The baths of a large city resounded with the loud shouts of the bathers, who, after the bath, were perfumed and barbered by clever slaves who made a special profession of this work.

In the time of Augustus, the first Roman emperor, women were forbidden to go to the public baths; but under later emperors this restriction was entirely removed, and every public bathing establishment had sets of apartments specially reserved for the use of the women. The Romans considered it highly improper for men and women to bathe together, and few women, except immodest ones, bathed with men in the days of the early emperors. But the practice of promiscuous bathing was gradually adopted, and Hadrian issued an edict forbidding the sexes to bathe in company. It proved, however, ineffectual, as the evil once introduced was ineradicable. The pernicious effect of frequent and luxurious bathing upon the character of the men is shown by the line of a Roman poet:

"Bathing, wine drinking and illicit love
corrupt our bodies."

The public bathing establishments of Rome were, as has been said, very extensive, including conveniences for bathing of all kinds, in hot and cold water and in vapor. They also had a double set of apartments, one for the men and the other for the women. The general plan and arrangement of the rooms and sections of a large bathing establishment will be easily understood from the following description of a set of baths at Pompeii, which, though by no means large, is yet fairly complete in its details, and in a state of excellent preservation:

There were six entrances to the baths from the street, three for visitors, two for slaves and attendants connected with the establishment, and the last for women. The women's baths were entirely separate, and there were no means of communication between their apartments and the rest of the structure. Entering at the main door, to the left is a toilet room; thence we pass into an open court, surrounded on three of its sides by a colonnade, which served as a sort of entrance hall to the rest of the establishment. Along one side of the entrance hall ran stone seats, upon which the slaves sat while waiting for their masters; visitors awaiting friends also sat here. Adjacent to the hall is a second toilet room, and a chamber appropriated to the use of the superintendent of the baths.

On another street is a second principal entrance, from which leads off a corridor conducting us to the Apodyterium, or undressing room, which communicates with the rooms set apart for the various hot and cold baths. Round the undressing room are stone or marble seats, on which the visitors sat while dressing or undressing. Near at hand are the Frigidarium, or cold water bath, and a little chamber, in which an attendant kept the clothes of the bathers. The next apartment is the Tepidarium, or warm room, which was kept at a pleasantly warm temperature by means of a brazier, the object being to gently break the change from warm to cold after the bather had emerged from the hot chamber on his way to the cold water bath. It also served as the place where the bather was scraped with a strigil, or metal scraper, and anointed with oil after bathing. In it are two bronze seats and several recesses, in which were kept the scrapers and the oils, unguents and perfumes, to be used by those who did not bring these luxuries with them.

From the Tepidarium, a door leads into the most important room, the Caldarium, which comprised hot water bath and alcoves in which those desirous of perspiring copiously sat. The flooring of this hot room is supported on low, brick pillars, and is hollow underneath: flues run up the walls, so that the room could be supplied with hot air from a furnace. The furnace served also to heat the hot water copper and the warm water copper. Near the room containing the furnace and the coppers is an apartment which the slaves who attended to the heating arrangements and the water supply occupied. This apartment has a separate entrance from the street, and two staircases, one of which leads up to the roof and the other down to the furnace. A small passage connects this attendants' room with a yard, where were stored the charcoal, wood, and other things required for the heating department. The yard also has an independent entrance from the street.

The rest of the space occupied by the Pompeian bathing establishment is devoted to baths for the use of women, which take up less room, but are just as complete in their details and arrangement. An independent entrance from the street gives admission to a small waiting room provided with seats. There is an undressing room, a cold water bath, a warm room and a hot room. The hot room is on the opposite side of the furnace to the men's hot room, and, like it, is lined with bricks or tiles, strongly clamped to the outer wall, but at a distance of a few inches from it, so that the hot air might circulate all round the apartment and keep it at an even high temperature. Thus the same set of apparatus heated the men's and the women's hot rooms.

The villas or country houses of rich Romans had private baths, which were precisely similar in arrangement and design to the public baths, but, of course, not large enough to afford accommodation to so many people at once. The suburban villa of Arrius Diomedes at Pompeii has a very good set of baths, comprising a court, a waiting room, an undressing chamber, a warm room, a hot room, a furnace, cistern and boilers.

A very good example of the raising of the flooring of the hot room is found in a bath at an old Roman villa at Tusculum, a favorite country resort of wealthy Romans. The floor of this room is supported on tubular tiles, which are hollow and perforated with holes to admit the hot air from the adjacent furnace room.

The walls of the various apartments were painted in tints and adorned with ornamental borders of stucco, stone or marble. On the walls were depicted chariot races, running horse races, figures of actors in amusing costumes and attitudes, and of wrestlers, tumblers and gymnasts in active exercise. These designs were spirited and lifelike, being copied from the works of great painters and sculptors.

After bathing, the body was scraped and anointed by a slave called an unctor or anointer. He scraped off the perspiration with the strigil, rubbed the limbs dry with linen towels and anointed them with unguents. On the walls of a sepulchral chamber on the famous Appian Way is a sketch probably copied from a well-known painting, which shows us the unctor at his work. Many various kinds of oils, unguents and perfumes were used; oil of saffron and an unguent made from the Arabian nard plant being favorite and costly preparations. Rich people took their own unguents to the baths in vessels of gold or alabaster; poor persons used those provided at the baths. The strigils and vessels for holding unguents were sometimes hung upon a ring, from which each article could be detached separately.

The usual hour for bathing was the ninth hour, or two p. m., the supper hour being the tenth. Under the empire, at any rate in summer, the time for bathing was one hour earlier. The satiric poet, Juvenal, describing a Roman lady going to the bath, gives a terrible picture of the degeneracy of the times. I translate the passage: "When she goes to the baths at night, she orders the fullest preparations to be made; she delights to perspire with a great tumult around her; and when her arms, wearied by violent exercise with the dumb bells, have dropped by her side, she sends for the anointer, who cleverly works her flesh with his fingers, and even ventures to pinch his mistress' thigh till she cries out. While taking her bath, she keeps a party of guests waiting at her house for supper. She is so long in coming, that they are half famished with hunger and thirst. At last she arrives, glowing with the exercise she has taken, and thirsty enough to drain a flagon at a draught; wine is brought to her in a vessel so large that it cannot be set on the table, but is put at her feet. Before eating, she tosses off a second pint of wine, drunk at a gulp that it may act as an emetic and serve to excite a ravenous appetite. After rinsing her stomach, the wine returns and falls in a cascade to the floor. Rivers rush over the marble pavement of the dining hall, and her lap smells of rich wine. She drinks that she may vomit and be able to eat and drink the more. Her husband, sickened at the sight, turns his head away, and with closed eyes, struggles to keep down his rising anger." This bitter satire on the licentiousness and corruption of the women of the later days of Rome seems to have been especially intended for the infamous Messalina, wife of the Emperor Claudius.

The most famous of all the Thermae, or Hot Baths of Rome, were those of Caracalla, which were situated between the Aventine and Caelian Hills at the end of the Circus Maximus. Mr. Francis Wey gives so excellent a description of them that I cannot do better than adopt it with a few changes. They form one of the most considerable monuments in the world and are the finest ruins in Rome. They were of vast extent, and could supply baths to 1,600 people at a time. But they were much more than mere baths. Besides the baths of different temperatures, the chambers heated by steam, the basins and fountains, they contained scent shops, stalls for articles of fashion, buffets for refreshments, kitchens and refectories, colonnades for conversation and walking in wet weather; libraries and reading rooms, a stage for the performance of comedies, an arena for running and wrestling and gymnasia for athletes. There was got together and administered by a numerous staff of slaves, artists and virtuosi all that could divert an indolent people and make it forget life. There were even picture galleries and museums of sculpture; pleasure was raised to the rank of an institution and organized on the plan of an architect. For sovereigns who had to maintain a power as absolute as it was fragile over a corrupt population, in whose breasts not even faith in their country had survived, the distribution of public amusements on an enormous scale was a political interest of the first consequence. Then the more the nation abases itself and grovels, the more does the ministration of pleasure increase in importance; the despots could only maintain themselves by becoming caterers to the amusement of the populace. The baths of Caracalla, completed by Heliogabalus, are the most magnificent of all; there several thousand citizens were able every day to exhaust the varied cycle of the delights of mind and sense.

The exterior buildings of the baths occupy a circle of 4,200 feet. In the court formed by these buildings there rose on walls of Babylonian massiveness and height another structure of several stories and nearly 700 feet long by 450 feet broad. The Caldarium, or hot room, a rotunda lighted from above like a conservatory, can be compared to one thing only, the Pantheon of Agrippa, which, though purer in its ornamentation, is not so bold in construction. What cannot be described is the imposing sight in the morning or at evening, of these gigantic walls, rising upon foundations plunged in shadow, the rounded tops of the vaults sharing the rays of the rising or departing sun with the mountain peaks. The portions of the edifice yet standing are like spires, towers or belfries, and can be ascended by steps from the inside. Mounting by these steps, you can pass along alleys bordered by broom and laurel, mixed with gaudy yellow gillyflowers, the border of flowers marking the edge of the abyss yawning on each side of you. Through the mighty arches the wind roars and whistles, sighs and soughs. As you look down, the long, deep shadows show the dizzy height of the great ruins. Some of the vaulting of the arches remains, and upon this you can walk, if your head is steady enough to resist the inclination to dizziness. Below, in ruinous courts and half destroyed chambers, are splendid examples of mosaic pavements, some of which, representing the portraits of victorious athletes, are famous. On the highest platforms you walk upon other mosaics, which were the pavements of the upper tiers of galleries, porticoes and terraces.—Education.

[FROM THE EUROPEAN EDITION OF THE N. Y. HERALD.]

VISIBILITY OF THE DARK HEMISPHERE OF VENUS.

THE planet Venus has just passed through a period which has been most satisfactory for observation and has been favored by a clear atmosphere. A brilliant evening star from the month of March until the end of August, she has presented a disk which has gradually become larger and larger, while her crescent has become more and more slender until the day of her inferior conjunction, or passage between the sun and the earth (September 19), on which her disk reached 59 seconds. On that day, from an evening star she became a morning star, and now she shines again, but before sunrise, with a splendid luster; her disk will gradually diminish and the width of her crescent will increase. Her maximum brilliancy as an evening star was on August 12; as a morning star it will be on October 24.

OBSERVATIONS AT JUVISY.

At the Observatory of Juvisy the beautiful planet has been the object of most careful observations. Our attention has especially been directed to the unexplained visibility of the hemisphere which is not lighted by the sun.

Every one has noticed the gray light of the moon, which shows us the entire disk of our satellite in the luminous crescent—what the English call the old moon in the arms of the new. This disk is sometimes so plain that the principal seas and mountains can be recognized by the naked eye, and it has even been successfully photographed.

This gray light of our satellite can easily be explained. It is due to the earth, which reflects into space the light which it receives from the sun, and which presents to the moon a disk thirteen and a half times larger and more luminous than that of the full moon. At the time of the new moon it is full earth for the moon. The gray light is the more intense in proportion as the light reflected by the earth is itself intense. It is brighter at the end of the lunar month than at the beginning, because in the morning the terrestrial globe presents to the moon a larger continental surface, whereas in the evening it is rather the ocean that faces the moon. It is also brighter when Europe is covered with snow.

DOES NOT APPLY TO VENUS.

It would seem, however, that the visibility of the dark hemisphere of Venus cannot be explained in the same way as the gray light of the moon. There is no star near to Venus, on the side remote from the sun, which can reflect light onto her.

The reflected light of the earth has been suggested, as in the case of the gray light of the moon; but although the earth, seen from Venus, is very brilliant, much more brilliant than Venus appears to us, since our planet, as seen from Venus, is entirely lighted up by the sun, whereas Venus, at her maximum brilliancy, has only a fourth of her surface lighted up (showing a crescent of 40 sec. in diameter by 10 sec. in width), does it give enough light to produce this effect? If we admit that the reflecting power of the earth as seen from space is the same as that of Venus (it is rather less), the circle of the full earth is to that of the crescent of Venus at her greatest brilliancy in the proportion of 60 sec. to 40 sec., or 8 to 2, as regards diameter. The surfaces of the circles being to

one another as the squares of the radius, it will be seen that the surfaces of the earth and of Venus are to one another in the proportion of 9 to 4. On the other hand, Venus, at her greatest brilliancy, only presents to us the quarter of the diameter of her lighted disk.

The earth should, therefore, send to Venus about eight times more light than Venus sends to us. We say about, for some of the elements of the calculation are rather vague, and no account has been taken of the distance of the sun.

We make this calculation on the assumption that the reflecting powers of the earth are slightly inferior to those of Venus, which is probably the case, according to the continual observations made of the brilliancy of Venus. We could make it in yet another way. The distance of the moon from the earth is 384,000 kilometers. The distance of Venus at the section of her orbit which is nearest to us is 41,273,000 kilometers. These two distances are in the proportion of 1 to 107. The intensity of light diminishes in the square of the distance. Therefore, earth light is for Venus, under the most favorable conditions, 12,000 times weaker than for the moon.

EARTH LIGHT IN VENUS.

We have just seen that Venus receives from the earth a light 12,000 times weaker than does the moon. On the other hand, the surface of the full moon is 13·5 times less in extent than that of the full earth. Therefore, the light from the earth received by intensity would be about 822 times weaker than that which we receive from the full moon.

It may be remarked, it is true, that the moon can be seen from Venus beside the earth, and that the little light of the moon is to be added to that of the earth. It is a thirteenth and a half to add, and the total intensity would therefore be about 882 times weaker than that which we receive from the full moon.

Will this light suffice to explain the visibility of the dark hemisphere of Venus?

We think not, especially as this hemisphere has been seen not only at the minimum distance, which we have taken as the basis of our calculation and toward the conjunction, but at a great distance and almost in quadrature. It is, nevertheless, to be taken into consideration, for it is far from being null.

It is certain that total darkness does not exist in the starry sky. (Speaking for myself, I can always see the time by my watch by the sole light of the stars, and yet the hands are very thin.) A planet is never entirely dark, even if we admit that it has no phosphorescence, no light of its own. But the result of observations made this year at Juvisy during the months of August and September puts the question in another light.

It appeared several times to M. Antoniadi, M. Georges Mathieu and myself that the interior of the crescent of Venus, that is to say, the part which is not lighted up, was darker than the sky.

It was not the effect of the contrast produced by the luminous crescent, for on the outside of the crescent this aspect was not noticed, but inside the disk became darker and darker toward the edge. The observations were made in full sunlight, Venus being on the meridian, about noon at the time of the conjunction and at all hours from nine A. M. to three P. M.

Now is it possible that a black body can be seen through the lighted atmosphere?

The tone of the darkened disk was slightly violet, but appeared rather darker than the sky than lighter.

The case is not, therefore, the same as that of the gray light of the moon.

It might almost be believed that it was merely an optical illusion, a sort of negative visibility, a tendency of the sight to prolong the fine points of the slender crescent, and theoretically complete the form of the disk.

But this explanation will not suffice either, for on hiding the luminous crescent the same somber disk is still seen, and then the interior of the disk is certainly darker and of another tone than the sky outside.

May not the entire globe of Venus project itself on a slightly lighted background, on the zodiacal light, on a very widespread solar atmosphere?

To sum up, it seems certain to us that the visibility of the dark hemisphere of Venus is not an optical illusion, and it seems to us that the explanation is to be attributed in the first place to the solar atmosphere, to the zodiacal light, before which the planet forms a screen.

FLAMMARION.

FRUIT DRYING.

A FEW weeks ago the London correspondent of one of our daily papers gave what he called "a striking illustration of the lack of resource of the British farmer, of whose woes so much has been heard." He went on to say that there had been such a glut of plums in England this year that the price of the best fruit fell to twopence a pound, which did not pay the cost of gathering and marketing, and, therefore, the growers sat down and allowed the fruit to fall and rot. If, instead of this, they had bustled around and dried the fruit, they could have had sixpence a pound in a month or two, and no fear of a glutted market, since England pays annually two and a quarter millions of dollars for dried plums imported mainly from France.

It is, no doubt, true that if glutted markets were ordinary experiences with British plum growers they ought to have prepared themselves to face such a probable danger. If, however, this state of things was altogether exceptional, it is unjust to accuse them of lack of forethought and energy because "they did not bustle around and dry their fruit," for, without the proper machinery and the skill which comes from practice, it would have been utterly impossible to dry a large crop of plums in such a way that they would be attractive, palatable and salable. It is very easy for newspaper critics to advise farmers to take up some new branch of agriculture when an old one fails, but the critic hardly realizes how much time and thought are necessary when the entire economy of a farm is to be readjusted. When there is an overplus of milk in the city and farmers are losing money on this product, it is quite easy to advise them to make butter, but this means a revolution in the entire system of farm practice, and it implies the work of years and the building up of a new plant by men who have no capital. In the same way, whenever grain farming or dairy farming becomes unprofitable, the farmer is counseled to raise fruit—that is, to learn a new trade and build up a new business; and if he is not prepared to do this on sight, he is reproached for his sluggishness just as the critic from whom we have quoted sneers at the "ridiculous conservatism" of the English farmer who wasn't ready with evaporators of the latest pattern to turn his plums into dried prunes at a moment's warning.

How to dispose of surplus fruit in times of abundance is, nevertheless, a serious problem, since it is hard to transport on account of its perishable nature, and still more difficult to keep in eatable condition. It is plain, therefore, that if it can be converted into such a form that it will endure shipping to any part of the world and will keep all the year round, the market for it is practically unlimited. The fundamental problem is how to prepare the fruit in such a way that its palatable and nutritious qualities can be preserved in the cheapest way possible. The canned fruit industry is an enormous one, but the demand for this product does not increase as rapidly as the demand for dried fruit, principally because the former is much more expensive. Dried fruit sells at about half the price a pound that canned fruit commands, and yet the material in one pound of dried fruit will make six pounds of canned fruit; that is, the fruit itself, when canned, not counting the sirup, costs twelve times as much as the same amount costs when dried. Another reason for the increasing demand for dried fruit is that when cured by the best modern processes it is much superior to what it once was. In California they have learned to prepare prunes so well that large quantities of them are shipped to France, the home of the prune; dried apricots and pears go to Europe by the thousand pounds, while California raisins have practically driven foreign raisins out of Eastern markets in this country, and are now exported in considerable quantities. Statistics are not difficult to obtain, but one needs a vivid imagination to interpret the dry figures in such a way that an adequate appreciation of the importance of this industry is secured. But when we think of three million pounds of prunes sent out from the single city of San José in one month, we gain some idea of the magnitude of the business, and we also get an idea of its rapid growth when we recall the fact that eight years ago this city did not take a car load of dried apricots in a year, while now it eagerly swallows up two hundred car loads.

But the prunes and apricots and peaches and plums and pears and raisins which are sent out from California by the train load by no means complete the full supply of dried fruit that is produced in this country. Bulletin 100, which has just been issued by the Cornell Experiment Station, gives an account of the production of one kind of dried fruit in western New York, and from this we learn that a thousand tons of evaporated raspberries are produced in Wayne County alone. Something like five hundred tons more are marketed from neighboring counties, and yet if the visitor should inquire for dried raspberries at any of the retail stores throughout that region he would hardly find a pound. Where, then, do these berries go? Probably four-fifths of them are consumed in lumber and mining camps of the West and on the plains, where fresh fruit is scarce. Very few of them are exported, and yet in cookery—that is, for use in pies, puddings and the like—these dried berries are nearly as good as the fresh ones. It ought to be added that raspberries are also dried to an important extent in southern Illinois and in Michigan, and more recently in Arkansas.

This bulletin gives an interesting history of commercial fruit evaporation in Wayne County, where, in apple-growing communities, nearly every farm has an evaporator of one kind or another, more than two thousand of these machines being in use in this one county. It ought to be remembered that, great as is the product of dried raspberries in western New York, there are more apples dried than raspberries, and after these in their order come peaches, pears, quinces, plums, cherries, currants, potatoes, peas, corn and pumpkins. This great business has grown up within twenty-five years. One little drying machine was introduced there in 1867 by A. D. Shepley, and the right to use it was bought by Mason L. Rogers, who in 1868 planted five acres of black raspberries, with the expectation of drying the fruit. The modern industry and the use of the word "evaporator" did not begin, however, until Charles Alden patented the tower evaporator in 1870. The original Shepley machine was only capable of drying three bushels of apples in ten hours. Now one of the establishments described in this Bulletin will evaporate three hundred bushels of apples a day, and another one has a capacity of five thousand quarts of berries a day.

It is not our purpose here to describe the various methods of making trays and moving them, or to explain the process of kiln drying, tower drying, steam drying, vacuum drying or air-blast drying with the various elaborate devices prepared to lighten every possible item of labor. We only use this as an illustration to show that it has taken years of experiment and expense to develop this business into its present form, and that even now considerable capital is required and great attention must be given to the plans of building, machinery, storage rooms, etc., if the business is to be made profitable. The sum of the whole matter is this. Bonanza farmers who sow wheat by the square mile can afford to sell grain at a few cents profit on a bushel, just as a large manufacturer is satisfied with a small margin of profit because of the enormous amount of his production. Under the growing stress of competition ordinary farmers cannot live on staple products at wholesale prices. But the farmer, to make something beyond wholesale prices, must put special intelligence into his work. He cannot live as his father did on industry and frugality alone. He must be prepared to meet some special want with a special crop, or he must add to one profit as a grower another profit as a manufacturer by turning his grapes into wine and his plums into prunes, or he must in some way use the machinery of his farm so that it will make something to sell besides the raw material which grows on his acres. This means that he must know more and apply his knowledge to better advantage. After twenty-five years of study and experience the farmers of Wayne County can make a profit with the most approved appliances after they have secured a good crop, and to secure a good crop constant and intelligent care must be exercised from the time the ground is prepared for the young plants until the manufactured product is put on the market in the most attractive form. The farmers of this country as a class are better husbandmen than their predecessors ever were, but they must have a still more thorough education for their work if they are to maintain the commanding position which the great body of tillers of the soil once held in the political and social economy of the country.—Garden and Forest.

THE

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